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	Page
The New Year	1
The Transfer of the Telephones	2
A New Year Letter to Ourselves	3
Continuous Current Motors, with Commutating Poles and Cast-Iron Magnets (*illus.*)	4
On the Efficiency of Accumulators (*illus.*)	6
A Lamp-Testing Board (*illus.*)	7
Simply Made Electric Heaters and Hot Cupboards	7
Correspondence :—	
The Association of Consulting Engineers	8
Old Carbon Ends and Lamp Caps	9
The Institution of Electrical Engineers	9
The Physical Society Exhibition (*illus.*)	9
British Trade with Russia	11
Business Notes	12
Electricity Supply at Keighley (*illus.*)	18
The Electrical Equipment of the Craighead and Bothwell Castle Collieries (*illus.*)	21
Failures of Steel Plates	23
Initial Condensation in Steam Cylinders	23
Notes	25
City Notes	29
Market Quotations	30
Stocks and Shares	30
Share List of Electrical Companies	31
Metal Market.—Fluctuations in December	33
Street Lighting (*illus.*)	33
Notes from Canada	35
Proceedings of Institutions :—	
An Automatic Starting Device for Asynchronous Motors (*illus.*)	36
Institution of Electrical Engineers	36
The Röntgen Society	37
The Physical Constants of Aluminium	37
The Benkö Primary Battery	37
Notes on Standards for Electrical Machinery	37
New Electrical Devices, Fittings and Plant (*illus.*)	39
New Patents Applied For, 1911	40
Abstracts of Published Specifications	40

Contractors' Column ... Advertisement pages xxiv, xxvi and xxviii

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THE NEW YEAR.

To the Electrical Industry we wish a happy and prosperous New Year. The familiar words come easily, but the mind, vainly trying to pierce the future, falls back upon the present and the past. It is inevitable to turn from the mysteries of the year that is to come, to the memories of that which has gone.

We are still too near to the old year to judge it fairly. The smoke of battle yet obscures the scene, and, perhaps, our vision is a little blurred. A busy year it has been for most of us, even prosperous for many. Employment has, on the whole, been good in our trade; but, though the output was large, competition was keen, and prices left but a small margin of profit.

The growth of central stations, so seriously checked by the arrival of the metallic-filament lamp, has recommenced in earnest. The older stations are bringing themselves up to modern standards of efficiency by adding exhaust-steam turbines; and that deadly enemy of fuel economy, the stand-by boiler, is being attacked, and will shortly be displaced, by the Diesel engine. Day-loads are developing in response to the quotation of low rates for power and heating.

Power users are beginning to realise the enormous advantage of possessing a reservoir of power upon which they can draw to the full extent of their requirements, without an instant's notice, day or night, paying only for what they use. And the absence of worries about coal supply, boiler inspection, and the smoke nuisance, is a minor factor which is influencing their minds.

Electric cooking and heating are making notable strides in public estimation. It is becoming known that electricity is not wasteful even as a medium for the distribution of heat, when the superiority of the cooking, the saving of weight and improved flavour, and the immense advantages as regards handiness and cleanliness, are taken into account.

One matter to which sufficient attention has not yet been given is the necessity for a hot water supply in the house at all times. The kitchen fire cannot be abolished in favour of the electric oven until the problem has been solved. The warming of rooms by electricity is another branch of the same problem which offers a good field for enterprise.

The general stagnation in the building trade which prevailed two years ago, has given place to a rather better state of employment, and this naturally nowadays calls for the services of the electrical worker. Electricity, of course, always has its best chances in a new district where gas pipes, chain armour, bows and arrows and other obsolete appliances do not require to be scrapped. It must not, however, be supposed that the building trade has "turned the corner," as the improvement in the statistics of unemployment derived from the various Trade Unions is stated as a percentage of total membership. Unfortunately for the figures, the membership has enormously declined;

large numbers formerly employed here in building having drifted into other trades or gone abroad, where, owing to rapid developments, there has lately been a larger opportunity for them to follow their accustomed occupations. It is our opinion that the local rating system, and the local spending system, must be thoroughly overhauled before anything like prosperity can return to this very necessary branch of industry at Home.

Electricity continues to make headway in the department of transport, and the cleanly, speedy, and convenient electric railways which now serve the metropolis are popularising the suburbs and the sub-suburbs, and, incidentally, raising the price of agricultural land to fabulous amounts—from which the persons who have risked their capital in producing the increase get little benefit.

A number of accidents on tramways have shown again the necessity for strict regulation of the service on steep hills and round curves, and the fact that the controlling gear still falls far short of perfection. The absence of "cant" in the rails, owing to the necessity of conforming to the surface of the existing roadway, adds greatly to the danger of curves. The opening of the railless trolley vehicle system in Yorkshire is an outstanding incident of the year, and in all probability 1912 will witness the running of such cars in many other parts of the kingdom.

Perhaps, in looking back over the past year, the labour trouble which has manifested itself in every trade is the most serious fact which indicates the problems of the future. It was largely due, in the first instance, to the great increase in the cost of living.

Some re-organisation of the relation of capital and labour seems to be required; and, to our mind, profit-sharing is the most hopeful of all the remedies available, though, unfortunately, Labour seems to be prejudiced against it. Increase of wages in some form seems inevitable; and if that involve increased cost of production, it is obvious that the cost of the necessaries of life must increase too, and the remedy will be worse than the disease, as our power of competing in the export trade will be crippled. Profits cannot be reduced. The margin is already too fine in most trades—particularly the electrical trades—to attract fresh capital. Therefore some scheme which, while raising the weekly takings of the worker, will also increase his productiveness, seems to be an economical necessity. Trade Unionism must be convinced somehow of the truth of this elementary proposition, and brought into line.

Many fine examples of the profit-sharing method might be cited, beginning with the South Metropolitan Gas Co.—all honour to the late Sir George Livesey—and ending with Lord Furness's unsuccessful attempt in the shipbuilding industry.

The increased cost of living, while it does not hurt the very rich, bears, perhaps, almost more hardly on the majority of our readers, the brain-workers of the electrical industry, than on those who work with their hands. Brain work is none too well paid, and the claims on a man in a black coat are heavy. Salaries have a nasty habit of remaining at the same level, even when the price of necessary commodities goes up.

Consulting engineers are having a hard time; and salaried men, whether in the commercial, municipal, or Government service, feel the pinch.

A wider survey is, perhaps, outside the scope of this journal; but we may be permitted to hope that the year now commencing will produce fewer wars, and rumours of war; and that Peace and Goodwill may be brought nearer to the dominance of the world.

Good counsel to this end may be found in Carlyle's "Past and Present." We venture to quote, in conclusion, two verses from his noble translation of Goethe's poem, "The Greatest German Man":—

> **The future hides in it**
> **Good hap and sorrow;**
> **We press still thorow,**
> **Naught that abides in it**
> **Daunting us—onward.**
>
> * * * *
>
> **Here eyes do behold you**
> **In Eternity's stillness;**
> **Here is all fullness,**
> **Ye brave, to reward you;**
> **Work and despair not.**

THE TRANSFER OF THE TELEPHONES.

"THE appointed day" has come and gone. The transfer has been completed without any outward ceremony—no drums and trumpets accompanied this overture to 1912. Private enterprise has been merged into State enterprise by effluxion of time and by the wholesale absorption of a working staff. To the mind's eye of the telephone man, 1912 has always been on the horizon, and it has not been always possible to realise that the original horizon has not changed, and that each day has made some progress towards reaching it.

It will not be within the power of all the transferred staff to recall the 31 years which have elapsed since the United Telephone Co., resulting from a fusion of the Bell and Edison interests, obtained in 1880 a licence from the Government to undertake the new work of telephone exchange communication, subject to the proviso that such licence might be determined at the tenth or any subsequent seventh year. It is not within the power of more than a small minority of the staff to recall the early struggles. The later management of Mr. Gaine is to most something more than a memory, but the management of Mr. Morgan is known only to a few, and to most of that few it unhappily results from the terms of transfer that their experience is no longer available to the development of the great enterprise.

The greatness of the enterprise is obvious to-day. Thirty years ago it was the few rather than the many who could realise that the invention of the telephone by Alexander Graham Bell, leading to the subsequent development of the Telephone Exchange system, was a greater accomplishment than any preceding work in applied science. We recall these points lest we should forget the honour due to these pioneers, whether individuals or represented by an incorporated company.

The company has had its times of storm and stress, and recurring periods of uncertainty of existence. The original restrictions in its areas were removed by Mr. Fawcett, thus conferring a benefit on the one hand, which was negatived by the encouragement of competition on the other hand. This competition, however, was for a time prevented by the operation of the patent laws.

The State's first participation in telephone work on a large scale came with the purchase of the trunk lines. The wisdom of the sale by the company was questioned in some

quarters, but it was defended by Mr. Forbes at a meeting of shareholders by one of those happy remarks in which he excelled on such occasions. He referred to the reeds and the storm, and to the superior position occupied by the reed which bent over that which broke.

The expiry of the patents naturally led to the formation of other exchange companies, of which the Mutual and the Duke of Marlborough's New Telephone Co. will be best remembered. The inevitable absorption following, there seemed to be some possibility of a period of comparative quiet, hopeful for development, but Mr. Hanbury interposed against the advice of the permanent staff of the Department, and encouraged that municipal competition which has resulted in no public benefit and no technical advance.

The second stage in the State's active participation came with the establishment of the Post Office London system, which brought co-operation rather than competition. Mr. Austen Chamberlain's recognition of the futility of competitive exchanges and the need for monopoly prepared the way for that complete absorption of the National system which has now been accomplished. It would be incorrect to say that the accomplishment gives universal satisfaction or is entirely free from causes of complaint. The dissatisfaction is common to all, or nearly all, State enterprises, and it would be impossible to carry through so great a transfer without some appearance of individual hardship. So far as the staff is concerned, the good-bye of Mr. Franklin and the welcome of Mr. Herbert Samuel are both in admirable taste, and the readiness with which the department, it is understood, has undertaken to remedy any errors in classification, is an indication of the desire to carry out in detail the sentiments expressed by Mr. Samuel in general terms.

From a survey of the past we come to a consideration of the future. Criticism may still be indulged in as to the wisdom of State management of the telephones, but such criticism is useless in effect, and in view of the accomplished fact may be ungenerous in inference. We prefer rather to dwell on the advantages of the situation and to look for the benefits.

For the first time the telephone service of the United Kingdom is free from restrictive influence. The estate has, so to speak, reverted to the freeholder, and covenants impairing progress no longer operate. The trunk service and the local services are in the same hands. Antagonism, real or fancied, no longer exists between the telegraph and the telephone. The co-ordination of the services has been provided for and the State not only controls, but also works all the means of communicating messages within the kingdom. These are important factors tending to development, and we look, therefore, with hopefulness to extensions on a considerable scale and to a rapid increase in the use of the telephone.

Le roi est mort; vive le roi!—is a phrase which serves to illustrate the situation. The change of government has been effected without apparent break. The expiring company established at its own risk, and carried on, a great public service under considerable difficulties and with no extravagant rewards to its shareholders. The Department which succeeds it in a difficult occupation is entitled to all the consideration which can be given to it and to all the help that may be afforded towards the development and the smooth working of the system. It must, however, be remembered that the Department has now acquired what we have called a great engineering enterprise; but the enterprise is capable of enormous expansion, and whilst commercial aptitude must have its effect in this expansion, it must be the province of the engineer to determine the lines of progress and to produce the most economical results. The effect of the engineering on the efficiency of the service and the cost of the service is direct and paramount, and it is therefore to be hoped that the Postmaster-General will lose no opportunity of utilising all the experience which may be available and of giving to the engineering branch of the Department the prominence and authority which it deserves and which are essential to the effectiveness of its work.

A New Year Letter to Ourselves.

ONE of the first matters to call for our editorial attention in the early days of this New Year was a grumble from a reader—we should judge quite a new one. No doubt it was decreed that the floods of good wishes that editors receive at such a season should not be permitted to spoil our humility, hence we take our correspondent's chastisement in the best of spirits, feeling certain that it was necessary for our good. While the old year lay a-dying a pen was busy protesting against the publication of "biased political articles" "constantly," and "one-sided political arguments"; it tells us that we are "abusive" and "narrow-minded"; and that we do not admit that there are two sides to every question; reminds us that "other people besides capitalists read the REVIEW"; dares to affirm that "there are a large number of intelligent men in the electrical world"; and that these hold "entirely opposite views" to ours; demolishes us with the remark "it is an insult to such men to force these articles down their throats"; and after demolishing us, leaves a veritable sword of Damocles suspended above our unworthy heads—or, to be more exact; our circulation.

How *can* we answer such a communication? The temptation is to make merry with such statements, but we will resist it, and try to answer the writer in a few sentences, and we hope that what we have to say will not meet with an unsympathetic reception in the minds of our readers generally. The ELECTRICAL REVIEW is an industrial as well as a technical journal, and when legislative measures or labour disaffection threaten to affect industry adversely, we regard it as our duty to express freely our conscientious opinion, whether *pro* or *anti* the Government of the day. Of course, when our views are different from those held by a reader, we are one-sided—but so is he! But we have no axe to grind, no interests to serve, save those of the industry. If a representative organ of the industry is to take no sides in the discussions of the day, it will be a weak sort of production and will in no sense lead its readers' thoughts.

The mere fact that we take one particular side is an open admission that there is another. Yes—there are among our readers those who are not "capitalists"—ay, very many of them—digressing, some of them have become capitalists because they *have* read us!—but is it only the capitalist who holds the views we express on labour and industrial questions? Far from it. Perhaps our correspondent refuses to recognise that in many respects the interests of the capitalist in industry are identical with those of the "worker." We have always recognised that difference of opinion between us and our readers is inevitable, otherwise we should never have so freely opened our "Correspondence" columns for argument. But abuse is not argument, and still less can anonymous abuse find admission there. We aim at furnishing a variety of matter, both industrial and technical, in each issue—we force nothing upon anybody. The reader will choose for himself what is of service, and matters might work a little more happily and smoothly if he endeavoured to recognise that there may be many who have a taste for what he abhors—even in an electrical journal. If Nonconformist divines can protest, as they have done in the *Times*, that they never preached a political sermon in their lives, surely we can say that we have never published a political article unless it was industrial also.

D

CONTINUOUS-CURRENT MOTORS WITH COMMUTATING POLES AND CAST-IRON MAGNETS.

By J. W. BURLEIGH.

THE writer believes it is generally considered impracticable, commercially, to construct an all-cast-iron magnet system suitable for continuous-current machines having commutating poles. It is, however, a feasible proposition to construct with an all-cast-iron magnet system, and at the same time secure the characteristics usually associated with sound design.

It is proposed in the following notes to describe the technical details of a machine so constructed; also to point out some interesting effects which will show where great advantages accrue.

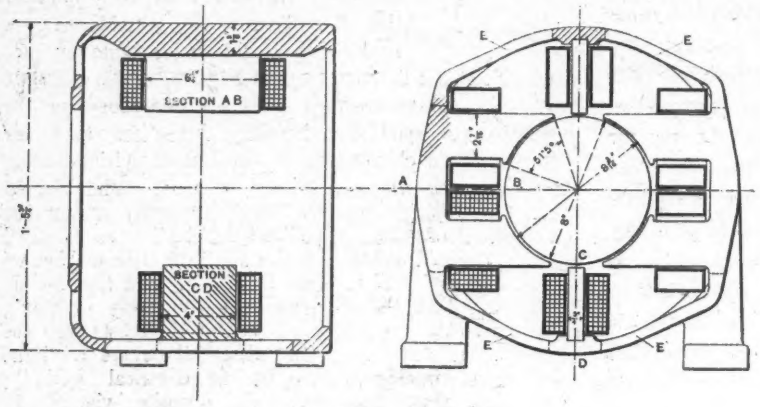


FIG. 1.

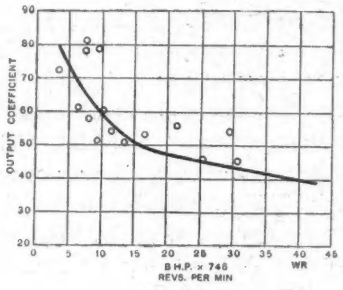


FIG. 2.

The construction is based on the magnet system described by the writer in the ELECTRICAL REVIEW, dated November 26th, 1909. Stated briefly, the magnets are so arranged that the angle between the axis of a main pole core and the axis of a commutating pole = 360/N.P., where N.P. equals the number of main poles.

In the interpolar spaces not occupied by commutating poles, the main field coils are brought directly over, and parallel, or nearly parallel, to the armature conductors undergoing commutation. Placing the field coils in this position

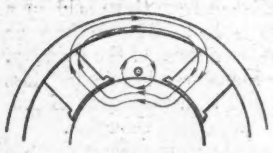


FIG. 3.

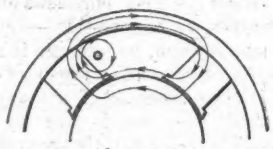


FIG. 4.

lessens magnetic leakage, and reduces the amount of copper required for the commutating poles.

Portions E E, fig. 1, being required only to carry the commutating flux, are cut away, leaving large ventilating spaces.

For comparative purposes, we will, first, consider the output coefficient of armatures. This output coefficient is usually expressed as follows:—

$$D^2 L = W_r \times C,$$

where D = diameter of armature in inches, L = length of armature in inches, W_r = watts generated per revolution per minute, and C = output coefficient. In the case of motors, W_r = B.H.P. × 746/R.P.M.

The curve shown in fig. 2 represents, I believe, the maximum coefficient required for the new type of machine. The small circles are for armatures by different designers, and are selected at random. It will be noticed that the curve shows an average value, and that even with all-cast-iron magnets, it is not necessary to increase the armature dimensions, as one might think would be necessary on first thoughts.

Smaller coefficients can, doubtless, be obtained, but it must be remembered that a small output coefficient does not always indicate minimum cost of total material. It frequently happens, particularly in small machines, that the armature dimensions may be increased for a given output, without affecting adversely the cost, the reason being that armature material is offset by the decrease in field copper due to the lessened density in the armature teeth and air-gap.

The ventilation of the new design is a great aid towards the use of an all-cast-iron magnet system. For a given temperature rise, it is found that the number of armature conductors may be increased from 20 to 30 per cent. This means for any particular output a like decrease in magnetic flux; nor must it be thought that, by increasing the number of armature conductors, and thereby the resistance, a diminution is effected in efficiency, or that the copper in the main circuit is increased. This is quite obvious, because we have saved the loss and copper in two commutating-pole coils; also there is less iron loss.

A remarkable fact connected with an all-cast-iron design is that the usual leakage coefficient is a negligible factor in the design. Neglecting a leakage coefficient and providing an excitation as calculated in the ordinary manner, will result in a greater magnetic flux than is required.

A reference to figs. 3 and 4 will assist a student in seeing that a reduction in magnetic leakage would be expected with the coils in the particular position of this design. Exactly why such a big effect is obtained in practice is rather difficult to realise.

As will be expected, the length of mean turn of field winding is greater than in the ordinary construction. The increased length, however, is very little, and is more than compensated for by the reduced excitation.

In diagram fig. 5 the full line represents the mean length of turn for the new design for outputs up to an equivalent

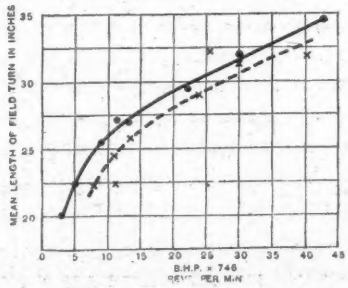


FIG. 5.

of 40 B.H.P. at 700 revolutions. The dotted line shows approximately the mean turn required for ordinary construction.

In fig. 6 the full and dotted lines represent respectively the ampere-turns per pole required for the new and for the ordinary construction.

Big differences of opinion will naturally occur as regards value of the mean length of turn and excitation, and probably for the ordinary and the improved design better figures

may be obtained. The writer believes, however, the figures given represent fair values for comparative purposes.

As is well known, the weight of field copper can easily be calculated by the following formula :—

$$\text{Net weight in lb. per coil} = \frac{(\text{A T S})^2 \times \pi^2}{\text{W} \times \text{C}},$$

where A T S = ampere-turns per coil, π = mean length of turn, W = watts per coil, C = a constant value 3,800,000.

We can now compare the field copper required for a motor with an output of, say, 10 B.H.P. at 1,000 R.P.M., having a W_r of 10 × 746/1,000 = 7·46. Referring to the curves for ordinary construction, we find the mean length of turn to be 22·25 in., and the excitation 2,400 ampere-turns. Allow, say, a loss of 50 watts per coil. From the above formula the net weight of copper for the four poles is 60 lb.

With the new design the length is 25 in. The excitation required is 1,900 ampere-turns. With the same watt loss the net weight of copper required is 47·5 lb.

It will be noted that in spite of the fact that cast-iron is used for the magnets the cost of field copper is not increased, nor is there a greater loss in excitation watts.

The following data relate to a reversible motor, which was tested for one hour at 10 B.H.P., 870 R.P.M., 460 volts, and also tested for six hours at 6 B.H.P., 920 R.P.M., 460 volts :—

Armature.— 8 in. diameter, length over laminations 6¼ in. ; 1 vent, ·287 in. wide ; 46 slots, 1 in. × ·26 in. ; number of wires, 1,918 ; size of wire, 18 B.W.G. ; weight of wire, 18 lb.

Commutator.—Diameter, 6¾ in. ; number of sections, 137 ; brush, ⅞ in. × ½ in.

Field Magnets.—Material, ordinary cast-iron in one casting ; bore, $8\frac{3}{16}$ in.

Field Windings.—

25 S.W.G. ;	4·2 lb. net weight ;	turns, 1,914	}	4,317 turns
26 S.W.G. ;	4·42 „	„ „ 2,403	}	per coil.

8·64 lb. per coil.

Interpoles.—Material : Wrought iron, 4 in. × ⅞ in. ; bore, $8\frac{3}{16}$ in.

Interpole Winding.—196 turns ; 11 B.W.G. 11 lb. (net) each coil.

Weights.		Effective areas.		Length of magnetic path.
Cast-iron... (including feet)	220 lb.	Armature	69 sq. cm.	6 cm.
Armature copper	18 lb.	Teeth	37·8 „	2·54 „
Field copper	34½ lb.	Gap	116 „	·239 „
		(effective)		·261 „
Interpole copper...	22 lb.	Field	98·5 „	10·75 „
Effective disks	39 lb.	Yoke	116 „	7·62 „

Weight of complete motor, 510 lb.

Test at 460 volts, 10 B.H.P., 870 R.P.M. ; temperature rise after 1 hour's run : armature, 54° C. ; field coils, 32° C. ; interpole coils, 47° C. ; commutator, 39° C.

Test at 460 volts, 6 B.H.P., 920 R.P.M. :—

Time.	Volts.	Armature amperes.	Shunt current.	Revolutions per min.
8.45	460	11·2	·50	840
9.45	„	11·2	·434	880
10.45	„	11·3	·42	900
11.45	„	11·2	·413	910
12.45	„	11·3	·408	915
1.45	„	11·3	·405	920
2.45	„	11·3	·405	920

Temperature rise after 6 hours' run at 6 B.H.P. :— Armature, 30° C. ; field coils, 42° C. ; interpole coils, 33° C. ; commutator, 25° C. Armature current when running light = ·6 ampere.

The loss in iron, bearings, windage, and commutator friction, is 276 watts. From this figure it will be apparent that the use of solid pole pieces is quite satisfactory.

I should like to point out that it is not at all necessary to use such a large number of commutator sections as embodied in the above design. It was done simply because 137 sections happened to be the nearest available commutator in stock. Moreover, a less number of slots could easily be used in this armature ; the output could then be increased about 20 per cent.

Fig. 7 is a magnetisation curve taken from this machine. Selecting a flux of, say, ·75 megaline or 125 English lines, we find the excitation required is 1,880 ampere-turns. The following figures represent the various densities and excitation required, calculated on the ordinary lines, and neglecting a leakage coefficient :—

	Density.	Ampere-turns.
Armature	10,850	40
Teeth	19,800	230
Gap...	6,460	1,300
Field	7,620	452
Yoke	6,460	204
Total		2,226

From these figures we gather that the calculated ampere-turns required for the iron path = 2,226 − 1,300 = 926, whereas only 1,880 − 1,300 = 580 were required.

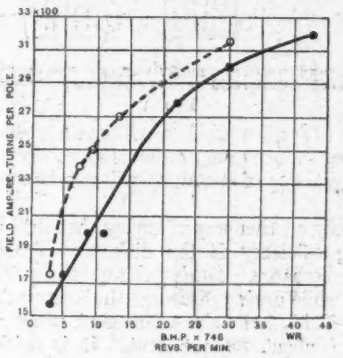


FIG. 6.

The reactance voltage at 6 B.H.P. = 5·6 volts. To neutralise this a density of 2,800 lines would be required in the interpole gap in a machine having one commutating pole per main pole. It would therefore be expected that double this density would be required if half the number of commutating poles only were used. This is not so, however, in the new design, as a density of 2,800 lines per sq. cm. was found ample for sparkless commutation.

The weight of the cast-iron magnet system is very little different from that of an all-steel magnet system of the ordinary type. Naturally, the areas are greater, but this is very

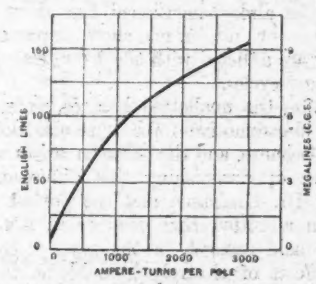


FIG. 7.

nearly off-set in consequence of the mean length of path for main magnetic flux being reduced to a minimum in the new design.

The new type of construction greatly lessens the machining required, minimises stock, and will not only effect a larger output from a given size of works, but will substantially reduce the prime cost.

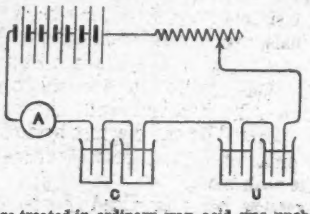
The efficiency is quite equal to that of steel construction, and the commutating properties are such that in a number of four-pole machines so far constructed, it was found that even with two consecutive rows of brushes lifted, at full load, there was only very slight sparking, and in some instances none.

In the machines so far constructed the cast-iron has been of quite an ordinary grade and worked at an apparent density of about 7,800 lines per sq. cm. up to 12 B.H.P. output. It will probably be found in the larger sizes that even an apparent density of 10,000 lines may not be too high.

ON THE EFFICIENCY OF ACCUMULATORS.

By W. HIBBERT.

If the efficiency of an accumulator is compared with an engine or dynamo, it seems to be low. The difference is not so pronounced if the operations of charge and discharge are of small duration and follow each other at once. But where a discharge runs on for seven or eight hours and is then followed by a corresponding charge, the efficiency found is somewhere near 80 per cent. Now, the work done in charge or discharge depends on three factors—volts, amperes and



Cells marked U were treated in ordinary way, acid was unchanged. In those marked C, the acid was changed twice every cycle.

Fig. 1.

hours—and under favourable conditions a good battery will return almost as many ampere-hours as were put into it. The loss in the quantity of electricity will not be more than 3 or 4 per cent.

This is only another way of saying that the chief factor in determining efficiency is the difference of voltage during charge and discharge. During charge, the average volts are nearly 2·2, while during discharge the average figure is about 1·95 volts. This factor alone, therefore, would determine an efficiency of about 88 per cent. It is evident that any appreciable improvement in efficiency must arise from a closer approximation between the charge and discharge voltage. The latter must be raised or the former diminished. The terminal voltage of a cell has the value $V = E - C R_i$ during discharge, and $V + C R_i$ during charge. If we assume that E and C have the same value in the two equations, the terminal voltage in discharge must be $2 C R_i$ below that observed in charge, and for any given current must depend on the internal resistance of the cell. At first glance, this difference might be thought to account for the low efficiency, but an examination of actual cells and the volts lost by internal resistance, shows that this is not the case. Resistance accounts for less than half of the 12 per cent. loss in volts. It may be responsible for about 5 per cent. of the total. That it does not cover the whole loss is shown by the fact already mentioned, that short cycles (a few seconds charge or discharge) show improved efficiency, although they are afflicted with the $2 C R_i$ loss quite as much as are the longer cycles.

To account for the unallotted balance, we must go to the fact that the electromotive force E is also different in the charge and discharge, and the question arises whether there is any chance of diminishing this difference. Since the researches of Dr. Gladstone and the present writer it has generally been admitted that changes in E.M.F. depend on differences in acid strength in the pores of the plates, and the known effects of electrolysis enable us to see how such differences arise.

During discharge the acid is abstracted from the liquid in the pores, which is therefore necessarily weaker. During charge, the electrolytic wandering of the ions makes the acid stronger in the pores of the positive plate, where it is most efficacious in raising the voltage. (See fig. 7, page 431, *Journal* I.E.E., 1892.)

In thinking of these things it occurred to the writer that this source of loss might be lessened by the following device. The efficiency of two similar cells was determined by charging the plates in weak acid and discharging them in stronger. In other words, at the end of a charge the plates were lifted from a box containing weak acid and put into another containing strong acid. At the end of a charge the reverse transfer was made. The current was kept at a predetermined value, and the potential difference read on a sensitive voltmeter.

At the end of a cycle the readings of the voltmeter were plotted against ampere-hours in the usual way, and the work put in during charge and that given out during discharge obtained from the enclosed areas.

It was thought that it would be too laborious to go through the usual repetition of cycles until constant results were obtained, and the early results were therefore compared with two similar cells in which the acid remained unchanged. In the final result, however, the experiments were repeated often enough to show that constant figures were being obtained.

All the cells were charged and discharged in series, so that the ampere-hours were the same for all. The voltage limits laid down were 2·4 for charging and 1·8 for discharging, as shown by the ordinary cells.

Fig. 1 indicates the general arrangement, and fig. 2 indicates the difference in voltage observed. By the change in acid, a *lower* voltage sufficed to charge, this advantage being somewhere about 0·06 volt. Similarly, a higher voltage was obtained in discharge, though the advantage here was only about 0·02 volt. The net result was of such an order that the efficiency was raised by about 5 per cent., say, from a value of 85 to one of 90 per cent. This is not quite so large as theory would suggest, but the reason is soon found. The method adopted is able to change the strength of the acid in the body of the cell at the appropriate times, but it is the liquid in the pores of the active material which determines the E.M.F., and this is changed merely by the slow process of diffusion. Hence the mechanical changing of the acid only partly accomplishes what was proposed, and so far fails to give the full effect desired.

We are brought once more to see what was asserted in Gladstone and Hibbert's paper, that an increase in the rate of diffusion would help. If diffusion could be so expedited that the acid in the pores could never differ much from that outside the plates, the charging voltage would not exceed the discharging value by more than $2 C R_i$. As a matter of fact, there is no chance of making diffusion take place rapidly enough, but as its rate increases with rising temperature, some efficiency cycles were taken at 30° or 40° C.

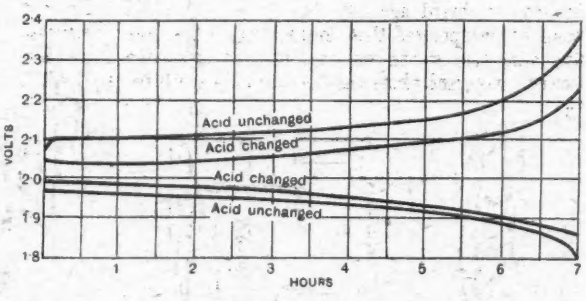


Fig. 2.

Two cells were placed in a water bath kept at about 37°, and placed in series with two similar cells standing in the ordinary air at an average temperature of 19° (July). Many cycles were taken, and gave practically the same result. (In these experiments the acid had the same strength in all four cells : temperature was the only difference.) The following short table shows the general nature of the results :—

Effect of temperature on the efficiency of an accumulator. Discharge current, 1·5 amperes ; charge, 1·3 amperes :—

	Ordinary Temperature.	37° C.
Discharge watt-hours	14·0	14·84
Charge " "	17·16	16·67
Efficiency	81·5	89·0

The average voltage of the warm cells exceeded that of the cold cells by about 0·07 volt. During discharge the difference was small.

The net result of these experiments shows that the efficiency of accumulators can be increased by two distinct methods. Both of these methods depend on the same theory, and, so far, they afford additional verification of the theory.

Whether either of the methods is capable of being used in practice is a moot question. Changing the acid twice in every cycle is an impracticable process. Keeping the temperature up is comparatively easy, but before it could be seriously proposed, the effect on "life" would have to be

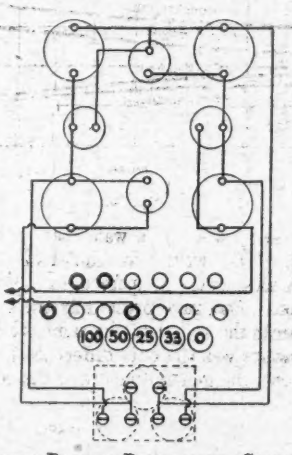
considered. Such evidence as is already to hand indicates that local action increases rapidly with temperature, and, therefore, that disintegration of the positive plates would probably be accelerated. Such a result would more than counterbalance any good accruing from increased efficiency. For the moment we must be content to look on the foregoing results as interesting demonstrations of the losses arising in accumulators. We are confronted by the facts that an increased rate of diffusion increases capacity and efficiency, but if it depend on higher temperature it will probably shorten the life of the cells.

A LAMP-TESTING BOARD.

By H. R. TAUNTON.

TESTING lamps on receipt and before despatch is an absolute necessity in these days of metal filaments. To any firm of contractors handling quantities of these lamps, particularly if they are of the varying voltages consequent on a country-house connection, a simple lamp testing board is indispensable. In a crude and clumsy way its place is easily filled by, for instance, half a dozen different pieces of flex connecting varying numbers of lampholders in series. To make up a simple, neat, fool-proof apparatus is another matter, and presents an interesting little problem.

Let it be required, for example, to design a lamp-testing board for a 100-volt circuit, so that four B.C., or four S.B.C., lamps can be tested either four in parallel, four in series, three in series, or two twos in series. It will be found that they can be connected up with suitable switches in quite a number of ways to give the desired result. It is difficult, however, to avoid the possibility of a combination of switches causing a dead short-circuit between poles; and, this pitfall dodged, to guard against the probability of the switches being so manipulated that lamps may be damaged by excessive voltage, as, at the best, it will be found that not less than two two-way, and three one-way, switches will be required.



LAMP-TESTING BOARD: DIAGRAM OF CONNECTIONS.

If the puzzle be attacked on the lines of using wall plugs to effect the necessary combinations, there is a gain in apparent simplicity, due to the double break afforded by the two-pin connectors; four plugs, or even—in one way—three plugs, will serve to do all that is necessary. A fatal defect, however, of such a board is that in certain combinations the pins of the connectors are unavoidably alive, and at different potentials. Besides, the possibility of mistakes on the part of the tester is still present.

The solution of the problem here given reduces the necessary gear, including the eight batten holders, to the compass of a standard six-way block; effects all the required combinations with a single simple fitting; and eliminates the chance of a mistake by anybody who is not either blind or mentally deficient.

The diagram shows the general arrangement and the connections. The eight lampholders are shown fixed on the upper two-thirds of a six-way block. (The S.B.C. holders can be placed between the B.C. holders, as, of course, the two types of lamps will never be tested simultaneously.) The remaining third of the block is occupied by two rows of small holes, about an inch apart. The single circles are dummy holes bored through the block, and taking a connector pin easily. The four double circles are holes having screwed into them, counter-sunk, the sockets taken from a couple of wall-plugs, the original terminals being attached to the ends projecting at the back.

The other essential part of the device is a special "six-pin plug." This is simply made up of three bases, complete with pins and terminals, taken from standard two-pin connectors, and screwed to a vulcanite block (about $2\frac{5}{8}$ in. × $2\frac{1}{8}$ in. × $\frac{5}{8}$ in. deep), so that the four pins in the bottom row are equally spaced and in alignment with the two pins in the upper row, as indicated on the diagram by dotted lines. The centres of the pins, of course, must coincide with those of the holes in the teak block.

Suitable wireways being provided in the vulcanite base, lengths of twin flexible are brought out at its two opposite ends and led through bushed inlets in the sides of the teak base, where they should be knotted, so that there is only just sufficient play to allow the "six-pin plug" to be moved in either direction to the extreme positions, and no further. This will prevent it being put in upside down, or otherwise effecting undesired combinations.

The various inter-connections having been made, and a pair of leads taken through the side of the block to the source of supply, the back is sealed up, or otherwise protected from the possibility of damage; small labels are fixed as shown, and an arrow mark is made on the flat top of the "plug" to serve as a pointer. The board is then ready for use.

As will be seen, the four lamps, whether in the B.C. or the S.B.C. holders, are placed successively in parallel, in series of four, in two series of two, and—one being cut out—in series of three, by moving the "plug" one hole at a time towards the right. A further move puts the "plug" into dummy holes entirely. The same principle can obviously be easily extended to a board suitable for a 200-volt supply, so that 25 and 33-volt lamps can be tested, as well as 50, 66 and 100-volt lamps.

Such a board is all that any contractor requires for testing lamps for defects. There are no loose, live ends; no possibility of arriving at a dead short-circuit; and—with the labels—no chance of the most freakish store boy making a mistake in the voltage, as each change is made by a single, simple movement.

SIMPLY MADE ELECTRIC HEATERS AND HOT CUPBOARDS.

By WHISTLEFIELD.

THE heating properties of carbon lamps can be usefully employed, and at least one firm of manufacturers uses a carbon lamp as the heating element of a guinea bedwarmer.

There are a number of small heaters which can be easily made and for which lamps form very suitable heating elements, the bedwarmer is probably the best example. All that is required is a tin about 8 in. long and 5 in. diameter obtainable from any grocer; a hole is made in the bottom of the tin and finished off with a file to $1\frac{1}{2}$ in. diameter; the lamp end of a cord-gripholder is inserted into the opening from the outside and the tin is gripped by means of the shade carrier ring.

A 5-C.P. lamp in the holder in the tin, and a length of flexible connected to the cord-gripholder and ending in an adaptor or plug, completes the apparatus.

A flannel bag large enough to slip over the tin and provided with a neck which can be drawn together by means of a tape, like a brush or sponge bag, gives it a more finished appearance, as well as making it more pleasant to the touch.

When the lamp is switched on, heat is given to the tin by the lamp at a uniform rate, and the temperature of the warmer will rise till it reaches a point at which the tin radiates the heat as fast as it receives it from the lamp; when this point is reached the temperature of the tin will not increase any more, no matter how long the current is left on.

A 5-C.P. lamp will maintain the temperature of a tin of the dimensions given at a comfortable heat all night among the bed clothes without the least danger of scorching; and since it consumes 20 watts only, will run for 50 hours before consuming 1 unit. If a much larger tin is used, a larger lamp may be required; but since the lid of the tin only has to be taken off to change the lamp, it is not a difficult matter to alter the heating element.

Another useful piece of apparatus of a similar nature is an electrically-warmed footstool.

A flat biscuit tin with a cord grip-holder fixed to a hole in the side of the tin by means of the shade carrier ring, completes the warmer; the bottom and sides of the tin should be lagged with sheet asbestos on the inside to prevent radiation at these places, and the lid alone should be allowed to give off heat; by doing this the radiating surface of the tin is reduced and a high temperature can be maintained by means of a smaller lamp than if the whole surface of the tin were unlagged.

The top of the tin should be very slightly padded, and the whole covered with a suitable cloth in keeping with the style of the carpet.

An 8-C.P. lamp will be found to give an appreciable warmth to the top of such a footstool, which, of course, is not meant for use with heavy outdoor boots, but only for the thin slippers which are usually worn in the house.

If desired, a switch can be attached to the side of the tin by means of a couple of $\frac{1}{8}$-in. bolts and nuts, and operated by the foot when the temperature needs regulating.

When a switch is used the flexible wire must be carried into the tin through a hole suitably bushed; a thin board, long enough to reach from one side of the tin to the other, is inserted and firmly fixed in position to leave about 1 in. space between the board and the side of the tin where the wire enters. A batten holder is attached to this board and wired in circuit with the switch. The board can be kept in place by driving a few sprigs into the end of the board through the tin.

Anyone who has to study in the early morning before any fires are available will find that a footstool like the one described, supplemented by a rug to keep the knees and legs covered will keep him very comfortable at a current consumption of 30 watts (8-C.P. lamp), or 33 hours' use can be got from such a footstool for the cost of 1 unit.

Another useful piece of apparatus for the house is a hot cupboard.

Again recourse has to be made to the family grocer for a suitable box, which should be about 24 in. by 30 in. by about 15 in. deep. The inside of the box is carefully covered by thick brown paper to make it quite air-tight, and over this is tacked thick sheet asbestos; strips of ordinary capping or thin wood are nailed over the asbestos along the edge of the box where the door will be fitted, to prevent the edge of the door fraying away the asbestos.

The door consists of one or more pieces of wood fastened together to make an overall size equal to the overall size of the box, and is covered with brown paper and asbestos sheet also, and strips of wood about 1 in. square are nailed along the inner side of the door at such a distance from the edge that it will fit tightly into the opening of the cupboard, and thus make a tightly closing door; a pair of hinges and a hook and eyelet for keeping the door closed complete the cupboard. A strip of casing long enough to reach from one side of the cupboard to the other, and having six batten holders attached to it is fixed along the back of the cupboard near the bottom so that the lamps lie horizontally. Two switches fastened on the outside of the box to control two lamps and four lamps each, will enable the user to get three heats—120-watt, 240-watt, or 360-watt—with 16-C.P. lamps.

A grid shelf just above the lamps, and another about the middle of the box, will give two shelves 12 in. high × 15 in. × 24 in., which is large enough for all practical purposes.

A small hot cupboard similar to this fitted with one 16-C.P. lamp, will keep baby's food hot right through the night, and available at any time at a cost which is trifling, especially when compared to the convenience.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Association of Consulting Engineers.

At the first blush the Association of Consulting Engineers appear a truly admirable institution, the only fear being that, when the great Gabriel himself is asked to be President, he may feel unable to live up to the high standard of the rules of conduct. We seem to have heard something of these rules before, and we can only be thankful that admission to the charmed circle does not demand first a remission by the high priesthood of the order, of the sins of omission and commission, of which candidates may have been guilty in the past, else had the membership been confined to the galaxy of stars, who, by virtue of their self-election to the high priesthood, have pardoned their own transgressions. But let us not labour this point too severely. Doubtless from the high plane to which they have attained they see more clearly from the hilltops the folly of breathing those valley fogs through which they themselves gasped and gulped with such avidity.

But when an outsider looks upon our various engineering associations, with the knowledge of years thrust upon him, he must be dull indeed does he not receive a mental impression of the order you dimly indicate. One and all, for no distinction is necessary, appear to be run purely for the special benefit of the galaxy. Just as bodies of financial people ring the changes in their boards of directors, so do we see rings and groups of names ever kaleidescopically shifting in the galaxy. A certain few appear to glide with facility into positions—by merit raised to that bad eminence—to become the objects of back-patting and buttered speeches at dinners and other functions, and these attentions are invariably mutual within the ring. Now, is it not a fact that all the advantages that can be claimed for the new Association ought to be, and might be, brought about by the existing institutions? Will not the new Association be simply another full-page advertisement to which all members will equally contribute, but which will blazon only the names of the galaxy of stars? Many of us have suffered from the advantages that have accrued to the galaxy by virtue of their position and the hidden influences unfairly brought to bear in their favour.

When Smith & Co. called for plans of a small power plant, what happened? Smith's freeholders were the Company of Charitable Bounders, and one of the firms who tendered for the work, told Smith that they had influence with the company, one of their men having been a Charitable Bounder, and they could easily override the stringent clauses of the freeholders. But they promised strong obstruction should any other firm get the work. How can the new society put a stop to such practices? We all know that they exist. The high priests know it. But did any one of us ever know any one of the Institutions ever to make the slightest move to protect the weak against the strong; to pillory those who break, not only the rules of the profession, but of common decency? Will a seat at the Council Board of the new Association convert a wolf into a watchdog? A fresh association is but overlapping a novel venture on a confessed failure. In present-day politics it is not all-round insurance to which the public really object. It is to overlapping.

The expenditure of the Poor Law is more than sufficient for the new arrangements to render the Poor Law unnecessary. But the old expenditure remains and the new overlaps it.

Before any new association is formed professing to do good to the profession, let the profession first convince itself that it is something more than a machine to exalt the few. Let

them ask the few how they are going to make a success for the members generally? And, if success is possible, why has it not been made with the older institutions? A secession from the older institutions could be understood, a casting away of the loaves and fishes of office and the Egyptian fleshpots. No great movement of reform has ever been carried through by men who have worked from inside a charmed circle; and no reform of the engineering profession can ever emanate from those who are in the ring, either fairly or unfairly. Until the various professional institutions are differently governed, they will continue in their present useless courses.

Council membership should be more frequently changed. The Council should be elected on a wider basis, and should cease to be a sort of freehold. The highest eminence in the profession should not even be held to entitle any man to remain on the Council beyond the limit. Nor should the Council at any time contain more than a very few men who have previously been members, and fewer still who have been contemporary members. The Council might occasionally become a bit of a bear-garden, but better a bear-garden than a smugly complacent group of the elect, who take care that criticism of their actions is howled down by a subservient few followers as disloyalty to the Council—such subserviency being usually regarded as a bid for a place in the sun. If members would kick a little and insist on a real reform they might get it, but only by refusing to cast the Councils in stereo.

As to the new rules, they are simply a humorous piece of humbug from such a source.

It may fairly be granted that any new member of Council may enter full of good intentions. But the position of any new member in the midst of any old-standing body is, at best, somewhat invidious. The well known insolence of the House of Commons to new members, whose rights are as great as those of older members, is a case in point.

This side of the situation would be relieved were a Council to consist always of a larger leaven of new members. Experience stands for much, 'tis true, but it has its qualifying disadvantages, not the least of which is the habit so quickly engendered of regarding the public park as a private preserve. As in politics, so in other phases of life, the permanent servant puts on the airs of the master and begrudges his master the smallest voice in affairs. I think the foregoing fairly describes the attitude of mind so far as has been revealed to me, who am

Merely a Paying Member.

Westminster.

Old Carbon Ends and Lamp Caps.

I shall be glad to know if any reader can suggest a use for old arc lamp carbon ends, both solid and mineralised.

Also to know what is the value of the platinum in an ordinary 32-C.P. metallic-filament lamp, and the average price paid at home for old lamp caps.

H.

Straits Settlements,
November 30th, 1911.

The Institution of Electrical Engineers.

The ELECTRICAL REVIEW for November 10th, 1911, containing references to the proposed new Articles of Association of the Institution of Electrical Engineers, has just reached here, and I write this by return mail, hoping that it may arrive in time for someone to take up the case of the members *residing abroad*.

With regard to the rearrangement of the membership, it is scarcely possible for all members residing abroad to be asked for their opinions, but with respect to the proposed alterations in the matter of annual subscriptions, some effort should certainly be made to ascertain the views of these members.

The unfairness of a *country* member having to subscribe the same amount as a *town* member was referred to both in your leader and by Mr. Solomon, but no one appears to have looked at the question from the point of view of the *abroad* members, the majority of whom do not visit England more than once in five years or so, and many at less frequent intervals even than that.

It would seem to be ridiculous that these members, who cannot avail themselves of the benefits to be derived from the proposals, as noted by Mr. Hammond, to inaugurate lectures by specialists, to hold summer meetings, &c., should be expected to subscribe annually the same amount as a member resident in London, and, up to the present, the subscription for an "abroad" member has, very properly and very naturally, been of a smaller amount.

Mr. A. Campbell suggested that not more than two guineas a year should be asked from Associate Members and Associates residing presumably in London, and I would further suggest that the subscription for the same classes of members resident abroad should be certainly not more than one guinea and a-half, as heretofore, and preferably not more than one guinea, this appearing to me to be a perfectly reasonable sum for a member who receives, in the matter of lectures, &c., nothing but his copy of the *Journal*, most of the contents of which, by the way, can be read in the weekly electrical papers—such as the ELECTRICAL REVIEW, &c.

The suggested one guinea may appear perhaps to be rather on the low side, but it would seem to be the best plan to fix some such amount as the annual subscription and to make, in addition, a further charge of, say, three guineas or so, as a visiting fee, this amount being paid by an "abroad" member when home on leave for his use of the Institution library, &c., during that time.

I trust this letter will catch the eye of some "abroad" member at present on leave, and that he will have the opportunity of taking part in the discussion from the point of view indicated herein.

Failing any individual taking this matter up, I should think that many members resident abroad would be glad if the ELECTRICAL REVIEW would do so, should this be possible.

One other point strikes one at the first perusal, and that is, "the Council may require candidates for Associate Membership to pass an examination, *or in their discretion grant exemption therefrom*" (the italics are mine). This rule would surely be very difficult of application.

A.M.I.E.E.

Straits Settlements, *December 5th*, 1911.

THE PHYSICAL SOCIETY EXHIBITION.

(*Continued from page* 1060, Vol. 69.)

FOSTER INSTRUMENT CO.

An interesting item of this exhibit was the Foster patent "strain-meter," for the direct observation of strains. This device can be attached to any member of a ship, crane or other structure

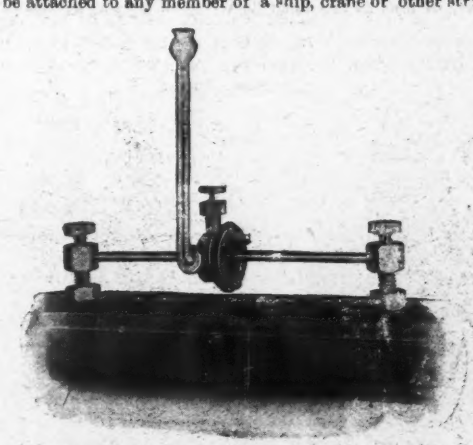


FIG. 2.—FOSTER STRAIN-METER.

and shows the strain due to any stress applied to the part under observation. It consists of two clamps carrying steel rods, one ending in a metal chamber provided with a glass gauge tube, and the

other bearing against a flexibly mounted diaphragm which closes the chamber. The latter is filled with coloured liquid, and when the slightest increase or decrease occurs in the strain to which the support is subjected, the movement is shown to a greatly magnified scale by the liquid in the gauge-tube—the increase being about 500 : 1. The device is applicable to a great variety of uses, and is extremely sensitive, measuring elongations to $\frac{1}{50000}$ in. The Hoskins "base metal" thermo-couples of nickel and chromium, which develop a large E.M.F., and can be used up to 1,360° C., and the Foster fixed-focus pyrometer were other exhibits.

Evershed & Vignoles, Ltd.

This firm showed the "Ducter potential ohmmeter," for rapidly measuring resistances from 10 microhms to 5 ohms; this was fully described in our issue of March 31st, 1911. Another exhibit was a speed indicator, consisting of a magneto generator in a water-tight cast-iron case, connected with a moving-coil voltmeter. We illustrate the former, which is of special design and construction. The armature runs in Hoffmann ball bearings, and the magnets are well aged to secure permanence and constancy. The armature commutator consists of substantial copper segments with air insulation, no mica being used between them, and the brushes are carbon blocks

Fig. 3.—Generator of Speed Indicator.

supported on wires stretched by springs; they are pressed on the commutator by rubber rods, to ensure perfect contact under the worst conditions of vibration. An adjustable magnetic shunt is provided to regulate the E.M.F. in the event of accidental variation in the magnetic field. The driving pulley is supported on ball bearings quite independent of the armature bearings, so that the strain of the driving belt is borne by the case and not transmitted to the armature shaft. Any of the firm's standard voltmeters can be arranged for use with the generator, and calibrated in revolutions per minute.

Crompton & Co., Ltd.

The Crompton potentiometer, which has been developed into a beautiful example of high-class design and workmanship, various switchboard instruments, and the Crompton road-wear measuring machine, as used by the Road Board, were shown, as well as the

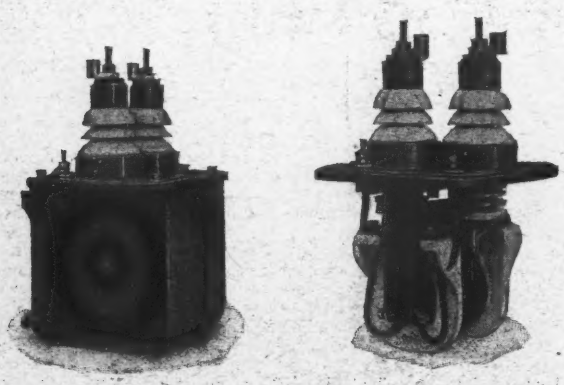


Fig. 4.—Highly Insulated Series Transformer.

battery switch and series transformer, which we illustrate herewith. The special feature of the latter is the provision of exceptionally substantial insulation between the primary and secondary windings, so as to render the device suitable for use on extra-high-pressure systems. The primary coil, as shown, is wound on a porcelain bobbin of high quality, which is so attached to the frame that no strain can be put on the bobbin; the transformer is enclosed in a cast-iron case, and the joint between the case and the cover (to which the transformer body is attached) is made with lead packing. The automatic switch is intended for battery charging; it closes the circuit when the dynamo voltage exceeds that of the battery by a pre-arranged amount, and opens the circuit when the current is zero or reverses. There are no permanent magnets in the construction, so that the switch cannot become reversed, and it is held definitely off or on when the battery or the dynamo voltage is in excess. It will be seen from the diagram, fig. 5,

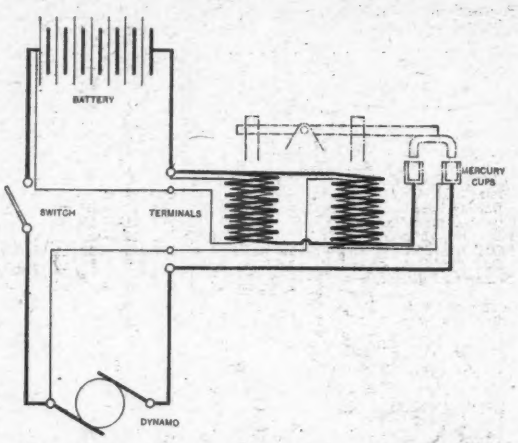


Fig. 5.—Diagram of Connections of Automatic Battery Switch.

that there are two shunt and two series coils, acting on a pivoted lever, which carries a bridge piece above two mercury cups. When the dynamo voltage exceeds that of the battery, the lever is tilted and the main circuit closed through the mercury cups; the charging current then holds the switch closed. If the current diminishes, the electromagnet nearer the mercury cups is weakened and the other strengthened, until, as the current approaches zero, the lever is tilted and opens the circuit. The switch is made up in a form suitable for switchboard use, and the shunt coils are wound for the full voltage.

The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The India-Rubber Co. showed a novel form of Wheatstone bridge of the decade form, embodying some radical departures from the ordinary type. In this instrument the usual method of construction has been reversed, and instead of the various resistance coils being

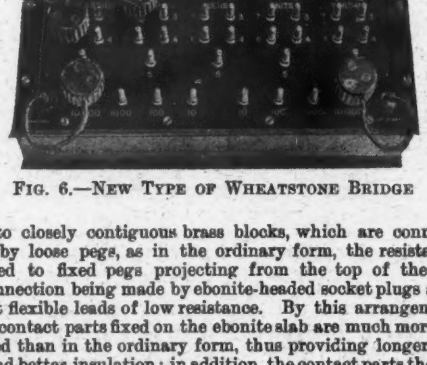


Fig. 6.—New Type of Wheatstone Bridge

joined to closely contiguous brass blocks, which are connected as desired by loose pegs, as in the ordinary form, the resistances are connected to fixed pegs projecting from the top of the ebonite slab, connection being made by ebonite-headed socket plugs attached to short flexible leads of low resistance. By this arrangement, the various contact parts fixed on the ebonite slab are much more widely separated than in the ordinary form, thus providing longer leakage paths and better insulation; in addition, the contact parts themselves and the insulating surfaces between them can be much more readily cleaned. All know the difficulty of cleaning the small ebonite surfaces in the confined spaces between the brass blocks of an ordinary bridge or resistance box, and the trouble and time required to keep the contact holes clean. The instrument exhibited had five sets of resistances, comprising 10 coils each of 1, 1, 10, 100 and 1,000 ohms respectively, together with four pairs of ratio coils, or a total of 58 coils. In the ordinary form of such a decade bridge there would be 63 holes to be cleaned, whereas in the new form there are only seven plug sockets, and these, being attached to the ends of flexible leads, can be turned about and held in the hand, so that the cleaning is much easier. As regards the plugs, the cleaning of these in either form of instrument presents no difficulty. In the new design there are no loose plugs to be lost or mislaid; and although this may not be thought a great advantage in a laboratory instrument, yet for a portable instrument, and for use in street work, &c., it is undoubtedly of importance.

This firm also showed three types of Mr. E. Raymond-Barker's two-tone vibrating transmitters for conductive and inductive signalling. One of these types was the latest improved form; it was generally similar to the instruments previously exhibited, which have been described in our columns, but the construction of the sending keys and of the vibrating tongues had been greatly simplified.

NALDER BROS. & THOMPSON, LTD.

This firm exhibited a portable standard ammeter and voltmeter of the "precision" type, on the dynamometer principle, suitable for D.C. and A.C., and free from error due to frequency, wave-form and temperature changes; an insulation tester for high-pressure circuits, also on the dynamometer principle, and used in conjunction with a transformer for measuring the insulation resistance of a combined 600 and 3,000-volt system at pressures 50 and 100 per cent. above normal in each case; the N.C.S. Telethermometer, the Ohmer, and other standard instruments and apparatus for portable and switchboard use. A circuit-breaker which the firm has just

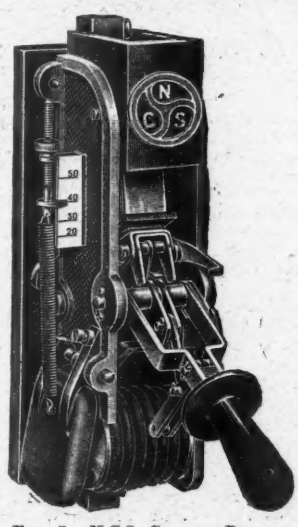


FIG. 7.—N.C.S. CIRCUIT-BREAKER.

introduced was also exhibited, and is illustrated herewith (fig. 7). This device is of neat and compact design, and of specially robust construction; it is fitted with magnetic blow-out and loose handle, but can be made with carbon breaks if desired, and is arranged in various forms, either for overload (with or without time limit), reverse current, or both combined, or with overload and no-voltage release. Special attention has been given to the tripping mechanism, which is entirely novel; the effort required to release the breaker is extremely small, so that there is no uncertainty about the operation of the device, but there is no possibility of its opening acci-

Two-circuit complete board with automatic device for giving signal in case of broken wire.

FIG. 8.—REICHEL TWO-CIRCUIT FIRE-ALARM BOARD.

dentally. The switch cannot be held in on an overload, on account of the loose handle; it can be tripped by hand, so that it can serve the purpose of a switch.

The latest pattern of the Reichel automatic fire alarm was shown; we described this instrument in our issue of December 2nd, 1910. It has the advantage that it automatically gives warning of any derangement of the circuits, and of the exhaustion of the battery.

The instrument in its earlier form was not provided with the trouble signal. It will be remembered that in essence the system consists of a milammeter movement of the moving-coil type, which is held deflected against the control of a hair-spring by a very small current; this current traverses a number of little thermo-piles, which are situated in the rooms to be protected. Should any one of the thermo-piles be slightly warmed, the added E.M.F. increases the current, and, therefore, the deflection of the indicator, bringing a light iron disk within the range of a magnetised iron pole-piece, which attracts it into firm contact, and sets the fire alarm bell ringing. Similarly, if a break occurs anywhere in the circuit, or if the battery runs down, the pointer falls back and makes contact with another magnetised stop, ringing a "trouble" alarm bell and attracting attention to the matter. As the permanent current required is only about 3 milliamperes, an ordinary dry cell serves to maintain it for a year or more. Leakage across the circuit, or a dead short-circuit, would also cause a bell to ring—either the fire or the trouble bell, according to the position chosen for the battery. The system is extremely sensitive; breathing on one of the thermopiles, or warming it with the hand, is quite sufficient to set up an alarm, as we have proved; but, on the other hand, a gradual change of temperature due to normal causes has no effect. Fig. 8 shows a complete board for two circuits, with adjusting resistance, testing devices, &c.

(To be continued.)

BRITISH TRADE WITH RUSSIA.

THERE can be no doubt that trade with Russia requires a considerable effort and a more than ordinary display of adaptability, but if this effort is made and this adaptability is practised, the results accruing will certainly be good. It has been suggested that, fortunately, the United Kingdom can afford to ignore a market that requires so much effort, but there can be no doubt that in the larger goods the trade is worth considerable energy. The Russian market would have done without a large number of things in which there is now a big trade had it not been for energetic selling on the part of our competitors. This selling has been largely carried out by extensive organisation, and it is by such organisation that British firms should endeavour to secure trade.

In a recent report Mr. Blakey, the British Vice-Consul at Kharkoff, who is himself a keen trader, points out that the establishment of what he describes as a purchasing agency would be a very useful institution. Comparatively easy to organise, and of considerable utility, it could be established on a purely commercial basis, with offices in London. It would have one or more experienced British travellers in Russia who would be in touch with manufacturers of machinery, chemicals, &c. It would issue lists or catalogues, supervise the shipping of goods and arrange for credit where necessary. If managed as a commission agency taking, say, from ½ to 3½ per cent. on the value of the purchase, it would bring down prices to a level that would ensure the support of the Russian purchaser. This could be done because British manufacturers are in the habit of quoting to London merchants lower prices than to foreign firms inquiring direct. There are several London and Birmingham merchants who have connections with Russia; *but the trade is not looked after by them, they merely accept orders that happen to come their way.* To be a success, this agency must concentrate its energy in Russia.

The scheme above outlined is interesting, and if properly carried out, would doubtless be of very great use. The whole crux of the position seems to us to lie in the statement in italics above (the italics are ours). We have no wish to attempt to depreciate the usefulness of the merchant. His value chiefly lies in the fact that he is in a position to finance small exporters, who would otherwise not be in a position to carry on an export trade, particularly in countries where the giving of credit is almost essential. It is a very illuminating fact, however, that in countries where the merchant system of trading operates, British trade has not advanced with anything like the same rapidity as it has in countries where trade is done direct. This can be safely said to be due chiefly to the fact that "the trade is not looked after by them, they merely accept orders that happen to come their way." If, however, they would direct their attention exclusively either to one particular market, or to one particular line of goods, there would not be the slightest reason why the trade should not expand as much under the merchant system as without it. Unfortunately, however, the merchant in most cases does not take the slightest trouble to find out what is wanted; the orders which he receives without any particular effort are sufficient to bring in a satisfactory total of commissions. But more important than this he has no particular reason, in most cases, for placing his orders exclusively with British firms, and is prepared to buy wherever suits his own purpose best. It consequently follows that if an institution on the lines of that suggested by Mr. Blakey were established, its practical good to British trade, if carried on on right lines, might be enormous, and if properly capitalised, it could exercise the same financial functions as are now exercised by the merchant.

In a previous report referred to in the ELECTRICAL REVIEW, Mr. Blakey showed the possibilities of the establishment of sale branches either for separate engineering firms or for a group of manufacturers. A dependent branch requires the services of experienced men and considerable financing, but in the long run it should give better results than can be expected from wholesale dealers or agents, however reliable or pushing, because an agent

cannot be tied down to put all his work and capital into British goods, and is free to trade in what is most profitable to himself.

In the heavy engineering, and more particularly in electrical engineering, the Germans have shown more enterprise than the British. They have branch offices in their own management with experienced engineers at the head, a staff of suitable men and branch factories in Russia to supply parts of contracts that cannot profitably be imported. They have thus established a reliable trade, while the British remain dependent upon the good will of their agents. The trade in electrical machinery and in semi-portable engines is entirely in their hands. Mr. Blakey is fully assured that the British manufacturer could well compete if he were as well served by a sales department in Russia as is his German rival, but entrance into this market, in face of the well-established German trade, is no easy task, and in the engineering section of the electrical trade it is particularly difficult. His remarks are not meant as an all-round condemnation of British enterprise in Russia. The returns of British exports to Russia prove that trade is carried on, in spite of considerable odds, but he considers that the volume of the trade is capable of considerable increase.

BUSINESS NOTES.

Bankruptcy Proceedings.—BERT NEWMAN (trading as B. Newman & Co.) electrician, 4, Cranbrook Road, Ilford, Essex.—The following are creditors herein :—

Gilbert Arc Lamp Co.	£14
Goodwin, A. F. & Co.	44
National Telephone Co.	17
Newman, F.	715
Partington Advertising Co.	12
Tolmage, G.	19

THOMAS TOPPING, electrical engineer, &c., 361, Lord Street, Southport, Lancashire.—The first meeting of creditors herein was held on Thursday, December 28th, at the Official Receiver's offices, 35, Victoria Street, Liverpool. The statement of affairs disclosed unsecured liabilities £359 and net assets £144, leaving a deficiency of £215. The debtor attributed his failure to loss on contracts and bad trade. The debtor commenced business in August, 1910, with £30 capital, his savings as a foreman electrician. The only books he had kept were an imperfect cash book and a debtors' ledger. He stated that he only became aware of his difficulties a month before filing his petition. The household furniture and effects were stated to have been purchased by the debtor's father-in-law, and given to his wife before their marriage in 1889. The debtor executed an assignment for the benefit of his creditors on December 4th, but the deed was not registered. With the exception of £83 for banker's overdraft, the whole of the liabilities are ordinary trade debts. The Official Receiver remains trustee.

Trafford Park Factories.—We have received the following notes regarding the progress of Trafford Park during 1911. Though not directly electrical, we think that they will be found of interest :—

THE SOUTHERN COTTON OIL CO., OF GREAT BRITAIN, whose parent company have 280 cotton seed oil works in America, opened new works in Liverpool last year. The company have now found the advantages of Trafford Park so considerable that they are erecting extensive premises in Trafford Park to turn out 2,000,000 lb. of lard per week, and they intend to scrap the new Liverpool works.

Another and yet larger concern that has come to Trafford Park is ANNEXE, LTD., a company having an exceedingly strong financial backing. Finding Trafford Park to be the best location in the country for their purpose, they are building a large works which will operate more than 50,000 tons of grain per annum.

MESSRS. JOHN GREENWOOD & SONS, of Blackburn, have just completed the erection of their large new flour mill in Trafford Park, on a site where they obtain direct communication with the Manchester Ship Canal Co.'s grain elevator. They will commence operations early in the New Year.

THE CO-OPERATIVE WHOLESALE SOCIETY have just made provision for extending their flour mill in Trafford Park, which is already one of the largest mills in the country.

THE MANCHESTER SHIP CANAL CO. have established a warehouse in Trafford Park for the storage of cotton. It is interesting to note that this is the only warehouse controlled by the Canal Co. in the Port of Manchester, which combines all the advantages of being within 6d. per ton rail haulage of every ship in the docks, of being directly connected with all the trunk railroads, and also of being situated on the Bridgewater Canal.

THE ENGLISH TEXTILOSE MANUFACTURING CO. have acquired extensive premises in Trafford Park, where they will shortly commence to manufacture cloth from paper materials by the Claviez process.

THE FORD MOTOR CO., of America, have recently chosen Trafford Park as the best location for their English factory, and have established extensive works.

Works are about to be erected in Trafford Park for the BROTHERS CHEMICAL CO., of Rawtenstall, who are moving to Trafford Park to secure the exceptional railway and shipping facilities.

MESSRS. A. BLAKE & CO., motor carriage builders, of Liverpool, have rented a small factory in Trafford Park for the manufacture of motor accessories.

THE BRITISH REINFORCED CONCRETE CO., LTD., are now building works in Trafford Park, where they will manufacture wire cloth for reinforcement, fencing, &c., under the Clinton patents, which are so successful in America.

MESSRS. JOHN DEWAR & SONS, LTD., the whisky firm, are building an extensive bottling and distributing depôt in Trafford Park.

THE DRAKE STREET PRINTING CO. are erecting a printing works in Trafford Park.

THE BRITISH DYEWOOD CO., of Bury, have just taken premises in Trafford Park.

THE DAHLSTROM METALLIC DOOR CO., of America, have rented a factory in Trafford Park.

Willans & Robinson, Ltd.—The first annual dinner of MESSRS. WILLANS & ROBINSON'S drawing office staff took place recently at the Grand Hotel, Rugby. Invitations extended to the general staff met with a hearty response, both from Rugby and branch offices, and Mr. E. R. Briggs (chief) presided over a numerous company, including Mr. F. R. Davenport, Mr. A. F. Bennett, Mr. H. F. Hemmings, &c. Mr. Davenport, in responding for the directors, complimented Mr. Briggs for initiating the gathering, and observed that it coincided with a period of increasing confidence as exhibited by an increasing order book. An outstanding feature of the latter was the cabled news recently to hand from Australia intimating that the New South Wales Government were accepting the company's tender for plant connected with electric railways and tramways, to the extent of some 40,000 H.P. The D.O. motto "Always Merry and Bright," hanging upon the dining room wall, displayed a cheerful optimism, which he thought might well apply to all departments. The dinner had been arranged partly to cement the feeling of friendly co-operation that existed amongst the departmental staffs, and he expressed the opinion that if that feeling was sustained there was nothing to prevent them from retaining their position in the first rank of engineering firms. A most successful evening was largely assisted by an extensive musical programme carried out by members of the staff.

Felten & Guilleaume, Carlswerk, A.G., Mulheim-on-the-Rhine.—We are informed that at a board meeting on December 23rd, the agreement concerning the fusion of the mines and blast furnaces of Jules Collart & Co., in Steinfort, Luxemburgh, with the Carlswerk, was approved. By extending the existing blast furnace plant and erecting a steel plant, this undertaking will be increased to such an extent that it will be large enough to cover the requirements of the Carlswerk in steel. The Luxemburgh firm will be transformed into a limited company, whose shares will be transferred to the Felten & Guilleaume, Carlswerk, A.G. It is as yet not intended to increase the share capital of the Felten & Guilleaume, Carlswerk, A.G., as the funds at the disposal of this company are sufficient for carrying out the transaction.

Calendars and Catalogues.—From the ELECTRICAL POWER STORAGE CO., LTD., of 4, Great Winchester Street, London, E.C, we have again received an exceedingly useful desk-pad with left-hand diary interleaved with blotting. Monthly card strips with the days and dates are fixed along the top edge of the pad. The usual accident insurance is included.

MESSRS. THERMIT, LTD., of 27, Martin's Lane, Cannon Street, London, E.C., has sent us one of their pocket note-books, with calendars for 1912 and 1913. The opening pages, as usual, are occupied with a good deal of illustrated information respecting the application of the "Thermit" system in tramway and other work.

THE WESTERN ELECTRIC CO., LTD., North Woolwich, London.—A neat, stout calendar has been received from this firm. It has monthly tear-off slips, and is intended either for desk use or for hanging.

THE BERRY CONSTRUCTION CO., LTD., 29A, Charing Cross Road, London, W.C.—Readers requiring copies of the 1912 "Tricity" cooker lists, with improved discounts, are desired to communicate at once either with the company, or with the sole wholesale agents, Messrs. Gillespie & Beales, Amberley House, Norfolk Street, Strand, W.C.

MR. JOHN WHITELAW, of 15A, Duncan Street, Edinburgh, has issued a calendar for 1912, with monthly slips fixed beneath a charming reproduction in colour of a painting, "Little Sister," by A. J. Elsey.

THE FOREST CITY ELECTRIC CO., of Collier Street, Greengate, Salford, are circulating a hanging calendar with large tear-off monthly sheets, each of which bears illustrations, with brief notes, of different types of their rail bonds and other specialities.

THE "ATTRACTA" ELECTRICAL CO., 75, Fetter Lane, E.C.—Circular giving illustrations, brief descriptive particulars, and prices of their electric illuminated signs—projecting for exterior service and shop-window signs for indoor use, also illuminated wood letters, portable flash signs, and other devices.

MESSRS. FIELDING & PLATT, LTD., Gloucester.—Large postal card illustrating their "Fielding" suction gas engines (52 and 60 B.H.P.), electric lighting type, and briefly indicating working costs and design features.

MESSRS. NEALE & WILKINSON, LTD., 32, St. Mary Axe, London, E.C.—Wall calendar with weekly tear-off slips. Valuable information, arranged in tabular form above these slips, indicates the time in important parts in the world when it is noon at Greenwich, and gives the time occupied in conveying goods and mails. Copies will be sent to applicants.

From the UNIVERSAL ELECTRICAL MANUFACTURING CO., of 14, Station Parade, Queen's Road, Peckham, we have received a useful pocket-book with diary spaces and squared memoranda pages. Illustrated particulars of the company's various manufactures in switchboards, switchgear, and street lighting fittings, together with a number of tables and curves, are sandwiched between these two sections. Calendars for 1912 and 1913 are given. The arrangement of the book admits of the addition of other pages as issued.

THE KORFUND CO., 47, Victoria Street, London, S.W.—Twelve-page catalogue relating to their "Korfund" cork plates for engine and other foundations.

THE BRAULIK ENGINEERING CO., 8, Lambeth Hill, Queen Victoria Street, London, E.C.—Thirty-two page illustrated catalogue and price list of electric specialities, including porcelain spider leading-in heads, aerial cut-outs, insulator switches, branch-off terminals for open-air cables, cone couplings, cellar and stable switches, the Sigma insulating box, the "Perkeo" electric barrel torch, electric press iron for shoes and other manufactures. A separate leaflet gives particulars and prices of the "Spider" triple switch and ironclad house service fuses.

MESSRS. SCHOLEY & CO., LTD., 151, Queen Victoria Street, London, E.C.—24-page catalogue prepared in excellent style with effective half-tone illustrations, and entitled "Accumulators, Ignition Coils and Dynamos for Houses, Cars and Vehicles." It contains descriptive particulars, with tabulated sizes, capacities, charge and discharge rates, prices, &c., of accumulators for various purposes—testing, small motor running, medical work, small lighting installations, traction, motor-cars, motor-cycles. The "De Luxe" type cycle accumulator; accumulators specially adapted for abroad; accumulator parts and plates; ignition coils; and the dynamo method of car lighting, are also fully dealt with.

MESSRS. DRAKE & GORHAM, LTD., 1, Felix Street, Westminster Bridge Road, London, S.E.—Illustrated pamphlet containing an illustrated description of the "D.G." adjustable reading lamp with revolving shade.

THE WALSALL ELECTRICAL CO, LTD., 57, Bridge Street, Walsall.—New catalogue of 40 pages, containing good illustrations, brief descriptive particulars and tabulated prices of their various manufactures in the way of switchboards for different classes of service, accessories, and meters. The company have just booked a large contract for meters (8,000), and they are extending the works to cope with the order, but their regular output will not be interfered with at all.

MESSRS. NALDER BROS. & THOMPSON, LTD., of 34, Queen Street, London, E.C., have issued a calendar for 1912, with monthly tear-off slips, in the same convenient size and style that has been found of service by us and others for many years past.

The standing desk calendar issued by MESSRS. STEWART AND LLOYDS, LTD., of Glasgow, Birmingham and London, is a white and gold production, and is quite different from anything else received. Monthly date sheets behind a transparent celluloid protection are changed by opening the back in the same way as with an ordinary portrait frame.

MESSRS. JOHNSON & PHILLIPS, LTD., of Victoria Works, Charlton, have once more prepared for their friends an extremely neat gilt-edged vest pocket engagement book for 1912, with ample daily space—two days per page.

MESSRS. A. EMANUEL & SONS, LTD., 7—13, George Street, Manchester Square, London, W.—Catalogue of 40 pages, giving illustrations and prices of a variety of electric light accessories, wires and cables, cords, conduits, casing, insulators, lampholders, "Kwik-Fix" ceiling roses, different types of switches, distribution boards, wall plugs, arc and metal-filament lamps, candle fittings, &c.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—A large mining calendar for wall service has been received from this firm. There is a separate sheet for each month of the year, and a distinctly useful feature is the printing at the top, on the right hand and left respectively, of the dates of the past month and the coming month, so that each sheet really represents a quarter of the year.

THE DUSSEK BITUMEN CO., of Canal Bank, Deptford, London, S.E., have sent us a handy self-opening pocket diary for 1912, with ample daily note space and cash account columns, also a few pages of general information. This is the only diary so far received this year containing that useful detail, the £1,000 accident insurance coupon.

"Wotan" Lamps.—MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., of Dalston, now have upon the market a complete range of their "Onewatt" lamps ranging up to 250 volts, and up to 600 C.P., made in the usual grades with filaments of pure drawn tungsten wire. Hitherto they have only placed upon the market certain candle-powers in certain voltages of this type of lamp, owing to the congestion at the works due to the demand for tantalum lamps. Extensions of the works and the acquisition of fresh stores have enabled them to accumulate a sufficient stock of "Onewatt" lamps to justify placing them upon the market, and immediate delivery can now be given of the full range of lamps shown in their new pamphlet. The name of the lamp has this week been changed from "Onewatt" to "Wotan," and these lamps will in future be known as the "Wotan" (Onewatt) lamps. Fresh literature embodying these alterations is being prepared for the trade.

Lamp Prices.—MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., of Dalston, announce that as from January 1st they have made various alterations in the prices of tantalum lamps, the most important of which affects the high-voltage lamps of 16, 25, 32 and 50 C.P., the prices of which are being reduced from 3s. to 2s. 6d. each. Other less important alterations are also given in a list which has been issued. We are informed that fresh types of advertising matter are being issued, and the firm will be pleased to supply quantities of literature free of charge to any member of the trade requiring same. We understand that the present reductions are not to be considered as a "price-cutting move," as there is now the same difference between the price of high-voltage tantalum lamps and of high-voltage tungsten lamps as existed previous to the reduction of tungsten lamps which took place last November.

Dissolutions and Liquidations.—AFRICAN TRANSCONTINENTAL TELEGRAPH CO., LTD.—A meeting of creditors is called for January 8th, at 2, London Wall Buildings, E.C.

HASTE PUMP CO., LTD.—A meeting will be held on February 1st at Crown Buildings, Crown Court, Old Broad Street, E.C., to hear an account of the winding-up from the liquidator, Mr. H. B. Clark.

BOHM LENS LAMP CO., LTD.—This company is winding-up voluntarily with Mr. E. S. Neave, 15, Great St. Helens, E.C., as liquidator. A meeting of creditors is to be held on January 9th. Claims should be sent to Mr. Neave.

RAWORTH'S TRACTION PATENTS LTD., late Cooper Street, Manchester.—In pursuance of the provisions of the Companies' (Consolidation) Act, 1908, a meeting of the creditors of the above was called for Tuesday last, at 113, Wool Exchange, Coleman Street, E.C. A meeting of the shareholders of the company had previously been held under the presidency of Mr. Thomas Browett, when a resolution in favour of voluntary liquidation was passed, with Mr. R. J. Riches as liquidator. The company had been in existence for a number of years, and at one time substantial profits were made. The present position has been brought about by litigation, in which the concern became involved. The only available assets are the patent rights, the value of which is not definitely known. There are debentures registered, and these form a first charge on the assets. Only a limited number of firms are interested as creditors, and the unsecured indebtedness is stated to amount to only a comparatively small sum. The voluntary liquidation of the company is being continued, with Mr. Riches as liquidator.

Electrical Engineering Trade Prospects.—MR. WILLIAM BULLOCK, of the Electric Construction Co., Ltd., Bushbury, near Wolverhampton, stated to a Press representative, in reply to inquiries respecting the prospects of the electrical engineering trade for 1912, that there is a fair volume of business passing, but that many of the prices at which orders have to be taken still prove unremunerative. Purchasers, he said, seem to put off their requirements till the last moment, and all machinery is required to be made and delivered in a desperate hurry. The consequence is that there is not a great amount of work ahead of manufacturers. The prospects of the new year are, added Mr. Bullock, fairly encouraging.

Trade Announcements.—THE ARMORDUCT MANUFACTURING CO., LTD., have taken additional premises at 9, Farringdon Avenue, E.C.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., inform us that owing to the continued increase of their business in all classes of supplies, they have again had to extend their premises at 39, Upper Thames Street, E.C. Extra space was taken about a year ago in the adjoining building, 38, Upper Thames Street, to enable them to carry a larger stock of tantalum and "Onewatt" lamps, but this has already proved insufficient. Their accommodation for stock is now more than double what was available in 1910, the new floors being chiefly occupied by "Zed" cartridge fuses, "Zed" distribution boards, arc lamp carbons, and accessories.

MESSRS. HARRY WITTUSEN & CO. have engaged as their London representative Mr. A. Griffin, formerly representative of Messrs. Johnson & Jorgenson, Ltd.

MR. J. STEVENS, electrician, of Upper Eglinton Road, Plumstead, S.E., has opened new showrooms at 31, New Road, Woolwich.

MESSRS. HANS RENOLD, LTD., have opened an office in Glasgow at 86, St. Vincent Street (Tel. 2454, Central), and have appointed Mr. F. M. Lawson, who has for some time held a leading position with the firm, as resident engineer for Scotland.

Private Meetings.—A. WARD & CO., LTD., 1, Endell Street, Long Acre, W.C., electrical engineers, &c.—The creditors interested in this matter met together a few days ago, when a statement of affairs was presented, showing liabilities of £3,250, all of which were due to unsecured creditors. The net assets stand at £2,278, or a deficiency as regards creditors of £973. The company was registered at the beginning of April, 1910, with a nominal capital of £3,000 in £1 shares. It was formed to take over an existing business, which was then carried on at 85, Shaftesbury Avenue, W.C., but shortly after the conversion the offices and showrooms were removed to Endell Street. The first directors of the company were Mr. A. V. Ward and Mr. C. L. Kirkpatrick, but since that time three other directors had joined the board. A suggestion was made that a joint liquidator should be appointed to act with Mr. P. E. T. Thomas, the liquidator appointed by the shareholders. A resolution to that effect was, however, defeated by a large majority, and the creditors decided to confirm the voluntary liquidation of the company, with Mr. Thomas as sole liquidator.

CARBURATION, LTD., 25, Mount Pleasant, W.C., manufacturers of carburettors.—A meeting of the creditors interested in this matter was held on December 30th at Bush Lane House, Cannon Street, E.C., having been convened by the liquidator, Mr. A. E. Watts. No formal statement of affairs was presented, but it was stated that the unsecured liabilities were under £200, while the assets if realised under a forced sale might produce £50. The appointment of Mr. Watts as voluntary liquidator was confirmed, and a Committee of Inspection, to act with Mr. Watts, consisting of Mr. Shepherd, of Langer, Shepherd & Co., the largest creditors, was resolved upon.

Book Notices.—*Glover's Vade Mecum.* 1911. Manchester: W. T. Glover & Co. Price 12s. 6d.—This handbook, which Messrs. Glover's are issuing to their friends, is a valuable compilation of information relating to the manufacture, laying and jointing of cables, the maintenance and testing of cable networks, colliery installations, overhead lines and interior wiring installations, with a variety of useful tables, data and official regulations. In the first section the usual types of insulated cable are briefly described and discussed, and the improved system of armouring patented by the company is shown. In the second section, trenchwork and reinstatement, the handling of cable, and the accepted methods of laying cable direct, solid and drawn-in, are admirably described, with an abundance of practical wrinkles obtainable only from long experience. The third begins with the statement that joints are *the* weak spot in cable work, and gives clear directions

for arranging cables in manholes, jointing them in various ways, insulating the joints, finishing cable ends, and applying joint boxes. Similarly, methods of testing cables and localising faults are lucidly explained, useful notes on colliery work are given (together with the Home Office Special Rules), the design and construction of overhead lines are treated of (with the Board of Trade Regulations appended), a short section is given on interior wiring (with the Home Office Rules for Factories, and the I.E.E. Wiring Rules), and a variety of tables and data follow, winding up with the Board of Trade Regulations, and a general index. The book—which is not a catalogue or price list—is extremely interesting, and should be found a valuable companion to mains engineers and contractors, as well as a handy book of reference to all engineers who have to do with cables and conductors.

We have received an advance copy of the "Annual Trade Review" of the Chamber of Commerce *Journal* dealing with trade and industry in 1911 and the prospects for the year just begun.

"*Transactions* of the Illuminating Engineering Society." Vol. VI, No. 8. November, 1911. Easton, Pa.: The Society. Price 75 cents.

"The School of Mines Quarterly." Vol. XXXIII, No. 1. November, 1911. New York: Columbia University. Price 50 cents.

"*Boletin* de la Sociedad de Fomento Fabril." Vol. XXVIII, No. 11. November, 1911. Santiago de Chile: The Society.

"The Stereophagus Pump and Special System of Pumping." By the Hon. R. C. Parsons. London: From the Author.

"Ship Wiring and Fitting." By T. M. Johnson 1911. London: Constable & Co. Price 1s. net.

"The Electrical Engineers' Diary, 1912." London: S. Davis and Co. Price 2s. 6d.

"Science Abstracts." Sections A and B. Vol. 14, part 12, December 27th, 1911. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net, each.

A Brimsdown Souvenir for Smokers.—From the BRIMSDOWN LAMP WORKS we have received a very acceptable New Year souvenir in the form of an aluminium tinder-box with igniting pencil, which, when we have filled in the necessary benzine, will considerably reduce our consumption of Editorial matches. We expect to find that one filling of the reservoir with benzine will suffice for three or four weeks' use.

LIGHTING and POWER NOTES.

Atherton (Lancs.).—The B. of T. has formally sanctioned the application of the U.D.C. to place overhead wires for the supply of electrical energy to premises outside the area of supply under the Atherton Electric Lighting Order, 1901. The electrical engineer has been directed to carry out the work.

Bacup.—As an evidence of the extension of the electrical undertaking, a sub-station is being constructed in Lee Mill district by the Corporation to serve the extension at Lee Quarries, and another sub-station is to be constructed at Waterbarn for the Stacksteads Quarries, the quarrying industry of the district employing 1,000 hands. The electrification of the quarries will expedite the output greatly.

Belfast.—The Corporation has recently acquired an Argyll 15-H.P. petrol motor-car for the use of its electricity department. The vehicle is to be employed in connection with the repair of electric cables, and for this purpose is being equipped with the necessary instruments for locating faults, and with the tools for carrying out repairs.

Cheltenham.—The T.C. has received the consent of the L.G.B. for the unexpended balance of £4,509, of a loan sanctioned in 1903, being utilised for mains (£2,103) in place of a loan of £2,000 sanctioned in May, 1910, and the balance towards the cost of works in respect of a loan of £6,548 sanctioned in July, 1904. Sanctions for the loan of £2,000, and £2,562 from the loan of £6,548, are to be cancelled.

Continental Notes.—BELGIUM.—La Compagnie Electrique d'Anvers et du Limburg is the name of a new concern which has just been formed in Antwerp with a capital of £30,000 to establish and work central electric lighting and power stations and to acquire a certain area of land at Beersse.

A new electric power plant of 5,000 KW. capacity is being installed at the iron and steel works of the Société La Brugeoise, at Bruges.

GERMANY.—The Electricitäts Gesellschaft Colonia is the name of a new concern which has lately been formed in Cologne with a capital of £20,000 to manufacture electrical plant of all kinds.

Derby.—With reference to the application of the T.C. for consent to supply current in the parish of Quarndon, the B. of T. has replied that, having regard to the demand for current, a prov. order should be applied for to enable the Council to give a general supply. The Electricity Committee has recommended the Council to undertake to apply in 1912 for a prov. order to include the parishes of Kedleston and Quarndon in the Council's area of supply, and to seek the consent of the B. of T. to give a supply in the meantime.

Eccles.—The borough electrical engineer has been instructed to visit the electricity works of a number of towns where mechanical stokers are in use, and to report thereon.

The consideration of the question of providing a showroom in the borough and of advertising the electricity undertaking has been adjourned.

The Health Committee is to be recommended to charge occupiers of the Corporation's houses in and near Lewis Street for the supply of electricity in the same manner as for the houses in Corporation Road.

Falkirk.—The T.C. has agreed to proceed with the work of extending the buildings and plant at the burgh electricity works, at an estimated cost of £5,800.

Glasgow.—A special report on the Corporation electricity department states that it continues to show progress. With improved trade conditions the set-back due to the introduction of the metal-filament lamp has been more than overcome. The department sold last year 40,823,000 units, being an increase of 4,344,000 over the previous year. The outstanding point in these sales is the large number of units sold for power purposes. These amounted to 23,523,000, an increase over the previous year of 4,000,000. No additional plant has been installed, and the amount of plant available continues to be 72,000 H.P. between the tramways and the electricity departments. The tramways department, however, has arranged for the installation of a Richardsons-Westgarth combined impulse-reaction turbo-generator of 7,000 H.P., and it has also erected a new sub-station in a more suitable situation in Partick, transferring the plant from the old sub-station with the addition of up-to-date switchgear. Applications to the number of 1,677 have been received during the year, bringing the total number of consumers up to 21,166. As previously stated, the demand for power purposes continues to grow, the number of such consumers added during the year being 308, representing 524 motors with a horse-power of 3,913. The total horse-power of motors in use is now 36,831.

Greetland (near Halifax).—The U.D.C. has decided to petition the B. of T. for a provisional order authorising it to supply electricity within the district, and further authorising the transfer of the order when obtained, to the Electrical Distribution of Yorkshire, Ltd.

Launceston.—The electric light was inaugurated on Saturday evening last, and very generally admired. The Launceston Electric Supply Co., Ltd., which controls the works, has acquired the quarry joining the London and South-Western Railway station. Mr. M. Willy is the resident manager, while Messrs. J. and W. Purves, of Exeter, are the consulting engineers.

Llanhedr, near Barmouth.—The Parish Council has decided to light the village with electricity. The power will be supplied by the River Artro.

Luton.—The T.C. has adopted a scheme for the extension of the electricity undertaking, and to meet the cost a loan of £17,000 is to be applied for. The Council has also decided, subject to a seven years' agreement, to supply current for power (600 KW.) to the Electric Furnaces and Smelters Co., Ltd., and has sanctioned mains extensions at a cost of £184.

Merthyr Tydfil.—The T.C. has approached the Merthyr Electric Traction and Lighting Co. with a view of ascertaining whether it is prepared to sell the whole of its undertaking to the Corporation. The borough engineer has also been instructed to make inquiries relative to the advantages of adopting the railless system of electric traction in the surrounding districts.

Mexico.—In the province of San Luis Potosi an English company has secured a concession to erect a hydro-electric station on the Verde River. Construction works are about to be commenced, and it is expected that 40,000 H.P. will be generated. A waterfall 260 ft. high allows of the utilisation of a head of 400 ft. The water level above the falls varies from 5 ft. to 25 ft. A good agricultural district lies around the falls, but the company intends to supply the towns of San Luis Potosi, Matehuala, Tampico, &c., with current, and, on the acquisition of other water rights, the city of Monterey also.—*Elektrotechnik und Maschinenbau.*

Newcastle-on-Tyne.—Mr. Glynn Marston, of the National Electric Light Association, of New York, visited Newcastle-on-Tyne on December 20th, in pursuance of an inquiry into the supply of electricity by the large companies in municipal areas. He stated, according to the *Newcastle Chronicle*, that the tendency in America was for municipal electric plants to be handed over to the large power supply companies, and, understanding that a good deal of this kind of thing was being done in Britain, he had been commissioned by his association to discover the terms of the contracts, and to discover the extent to which the power companies were taking over the municipal undertakings. Mr. Marston said that he found that the Newcastle Electric Companies could supply power cheaper than the collieries could generate it with their own coal, for that reason companies in the Newcastle district were supplying some 52 collieries. The explanation was that the big power companies were able to handle the waste heat problem economically, whereas the small companies and the municipalities could not do so. Mr. Marston also pointed out the necessity for the demand for current spreading over the whole day if the generating were to be done cheaply. In Newcastle that condition prevailed, but in America the National Electric Light Association, to bring that condition about, had had to encourage the use

of electric vehicles. He could give no explanation of the fact that such vehicles were unknown on Tyneside, except that the power companies had not found it necessary to seek this class of business.

New Zealand.—A proposal to borrow £12,000 for the extension of the electric lighting and power works at New Plymouth has been approved on a poll of the ratepayers of the borough.

Portishead.—The Portishead and District E.L. Co. has secured from the Bristol T.C. a site in Gas Lane on which to erect a generating station, the building to cost not less than £1,000.

Queensbury.—The Halifax T.C. has informed the U.D.C. that it cannot entertain the question of supplying current in bulk to Queensbury.

South Africa.—The estimates for the municipal year ending July 31st, 1912, have just been published by the Durban T.C., and show a surplus towards which electric light provides £11,601; tramways, £14,838; telephones, £4,000. Of the electric light revenue, private lighting will give £31,900; power, £5,840; Corporation Departments, £5,927; street lighting, £7,410; tramway supply, £14,524; and Government supply, £3,125. The electric light expenditure is put down at £68,726, of which interest amounts to £12,479; renewals, £9,210; contribution to rates, £11,601; sinking fund, £2,234; and the construction account amounts to £70,447.

The tramway revenue is shown at £119,193, and expenditure £104,355, while out of renewals account £9,970 is set aside for relaying West Street track and the construction account amounts to £45,473 for extensions of track to Overport, Prospect Road and Bath Road, being a total length of 1·4 miles.

One of the features of the estimates was the announcement of the reduction of the price of electric supply which came into operation on December 1st, being 6d. per unit, as against 7d. previously. This is subject to a discount of 10 per cent. for all accounts paid within seven days, so that the net price is about 5½d. A day rate of 1d. per unit is also introduced, with a minimum charge of 5s. per month, the 1d. rate applying only between the hours of midnight and 6 p.m. This applies to a certain class of consumer, while a day rate of 2d. per unit applies to another class of consumer. For motive power the charges are from 2d. to ½d. per unit as heretofore, depending on the units consumed, but the minimum charged is £3 per H.P. per annum up to 20 H.P., which charge was previously a standing charge in addition to the cost of current consumed.

The tender of the Municipality of Muizenberg and Kalk Bay for the supply of electric energy, having been accepted by the Wynberg Municipality, the sanction of the ratepayers of Muizenberg and Kalk Bay was required to the raising of a loan of £4,500 for overhead mains, &c. Strong opposition was raised to the scheme by some of the ratepayers, and a poll was taken on December 11th, with the result that the proposal was rejected. The Wynberg Municipality is consequently advertising for fresh tenders for street lighting and supply to private consumers.

Skelmorlie.—On the evening of December 28th Lady Montgomerie inaugurated the electric lighting supply in the Skelmorlie district of Ayrshire. The plant installed some years ago by Dr. Philp to light the Wemyss Bay Hydropathic, and extended afterwards by Mr. R. V. Farnham to give electricity to several neighbouring houses, is now owned by a private limited company which, after obtaining a B. of T. order, has erected and equipped a power station with plant for the day and night service of the whole district. The gas engines (two of 100 H.P. each and one of 35 H.P.), are supplied from three suction gas producers—one "Crossley," one "National," and one designed by Mr. R. V. Farnham. The dynamos and booster are by the Electric Construction Co., the storage battery by the Tudor Co., the switchboard by Kelvin & James White Ltd., lamp-posts by the Edison & Swan Co., and the public and private lighting cables by Messrs. Callenders. The running plant alone can supply 5,500 25-C.P. lamps. Mr. John M. M. Munro is the consulting engineer. Following upon the inauguration the company met at the Hydropathic for dinner, where felicitous speeches were made. Mr. J. H. Montgomerie, chairman of the County Council District Committee, said the company had been most generous in its charges for public and private lighting. The season for public lighting—and the charge would only begin then for the first time—was to be from August 1st until April 30th, instead of from September 16th till March 31st, as formerly, whilst cottagers requiring a room and kitchen lit, were to be supplied at the rate of 10s. per light, or £1 per annum. He defied any gas company to give light at the price.

Stalybridge.—It was decided, at the monthly meeting of the Stalybridge Joint Tramways and Electricity Board, to make application to the L.G.B. for sanction to a loan of £16,850 for additional plant at the generating station at Stalybridge. The extensions include new turbines, pipework, boilers, mechanical stokers, &c., and £5,000 will be set apart for the purchase of transformers and switchgear during the next three years.

Thurstonland.—The U.D.C. is taking steps with a view to securing a supply of electricity for public lighting.

Wootton.—The P.C. has resolved to approach the E.L. Co. on the question of introducing electricity into the parish for lighting and power.

Wrexham.—The T.C. on December 29th adopted a revision of charges for electric supply to dwelling houses. In future house consumers may pay a minimum of 12½ per cent. of the rateable value of their premises, in return for which 48 units will be allowed for every 20s. paid of the minimum figure, the charge after the consumption of this quantity per 20s. being 1½d. per unit, less ½d. per unit discount. Councillor Sauvage (chairman of the Electricity Committee) said he used the electric light in his house, and found it infinitely cheaper than any other illuminant. The output of the E.L. department during November was 73,075 units, or nearly 10,000 more than in the corresponding month last year.

TRAMWAY and RAILWAY NOTES.

Ardsley.—The B. of T. has informed the U.D.C. that it is inexpedient to grant the application of the Wakefield and District Light Railway Co. for cessor of powers in respect of unconstructed portions of the lines authorised by the order, with the exception of a short length in Horbury. The Board has, therefore, extended the time for the completion of the lines for a year, and expresses the hope that in the interval, capital will be found to complete the work.

Belfast.—At a special meeting of the Tramways and Electrical Committee last Friday, the report of Mr. Andrew Nance, general manager, was read *re* the proposed extensions of the tramway system authorised by the recent Act of Parliament and the Act of 1904. After discussion, the city surveyor and the electrical engineer were instructed to prepare plans and specifications and forms of tender, and do other matters requisite, in order that tenders may be obtained. Work is to commence about March 1st, and will terminate early in the summer. The general manager was instructed to take measures to increase the stock of cars from 250 to 300, in order to provide additional cars for the new routes. A depôt is also to be built at Ardoyne. It is understood that the estimated cost of the permanent way and the electrical equipment will be about £115,000, and of the new cars about £36,000, or a total of £151,000.

Blackpool.—It is proposed to relay at the earliest possible moment the tramway track along the entire length of the Promenade at North Shore. The estimated cost of the work is £10,000, and the Finance Committee has decided to apply for sanction to borrow this amount.

Birmingham.—As from January 1st, the Corporation entered into possession of the whole of the tramways in the Greater Birmingham area. The sections affected are those controlled by the B.E.T. in Aston Manor, and portions of the Selly Oak and Sparkhill routes; the company's interests are to be purchased for £151,000.

Chile.—The Ferrocarril Eléctrico de Santiago a San Bernardo is to construct various sections of electric railway. The work must be commenced within six months and completed within one year.

Continental Notes.—AUSTRIA.—The preliminary studies for the construction of electric tramways have been officially sanctioned at Schwechat, in Lower Austria, and between Ried and Frankenburg, in Upper Austria. Similar authorisation has been accorded for an electric railway line to connect the curative resort of Bad Gastein with Hof Gastein. Authorisation has also been accorded for the electrification of the Mori-Arco-Riva line, on Lake Garda, and for the construction of an extension to Sacco and Rovereto; also for the conversion of the Pirano to Portoruse line into a normal electric railway.

Some interesting particulars were given of the projected electrification of the Austrian State Railways at a recent meeting of the Railway Consultative Council. A closer study of the conditions of the line from Opcina to Trieste has shown that the financial advantages are not on the side of electrification, and in consequence it has been decided not to proceed with this conversion. The inquiry into the Arlberg line is still proceeding. The preliminary work in connection with the Attnang-Steinach-Irdning line is almost completed, the detailed scheme having been drafted, and only the political aspects remaining for consideration. The mode of the provision of capital has also been decided upon. The electrification of the section Selzthal-Attnang-Puchheim has, for technical reasons, been abandoned.—*Elektrotechnische Zeitschrift.*

It is reported that a service of electric motor-omnibuses is about to be started in Vienna.

RUSSIA.—A Conference was recently held at Wladikawaka to consider the question of building an electric railway and tunnel through the Caucasus. At the Conference were present eminent Russian and foreign engineers, among the latter being Chief Engineer Zoellinger, who was associated with the building of the Simplon Tunnel, and Prof. Hannings, the builder of the Albula Tunnel. It is estimated that the building of the tunnel will take eight years, and will cost 100,000,000 roubles. The tunnel will have two galleries; the mountain streams can supply over 13,500 H.P. for traction purposes.—*Zeitschrift des Oest. Ingenieur und Architekten Vereins.*

GERMANY.—As previously announced, the Bavarian Government has given the contract to the Bergmann Co. for the construction of the electric railway from Garmisch to Partenkirchen, through the Mittenwald to the Austrian frontier (Griesen). This line is 40 km. long, and is regarded as an experiment. If it proves a success, it will cause the electrification of the Munich-Partenkirchen line, now

worked by steam. These two lines will create an electric main line connection between Munich and the Austrian frontier (Griesen), whose continuation to Innspruch on Austrian territory will be effected by the projected Mittenwald electric railway, which is about to be constructed with the co-operation of the Austrian Creditanstalt. These several lines will form the shortest route for tourists through Germany to the Brenner Alps. The power station for the Bavarian section will be erected on the shores of Lake Walchen.

A scheme has been drawn up by the A.E.G. and Siemens concerns for the construction of an electric railway between Cologne and Düsseldorf.

ITALY.—A concession has been granted to the Società Anonima Agnone-Pietrabbondante-Pescolanciano for the construction and working of an electric railway in Agnone.—*Elektrotechnik und Maschinenbau.*

Edinburgh.—Mr. Hall Blyth, chairman of the Cable Tramway Co., had something to say relating to the cost of cable traction at the annual dinner of the employés. They had 14 main routes on the system; the cables varied in length, the shortest being 4,500 ft. long, and the longest 33,600 ft. long, and the total length of all the cables was 293,000 ft. The cost of the cables was £10,000 each year; but with the breakdowns that took place, the actual cost for last year was £17,166. The lives of the cables, of course, varied, from 92 days on certain routes to 415. These were the lives guaranteed by the makers. The actual average for the whole system was 267 days. They had in addition to 14 main cables 12 auxiliary cables, and their life was about 57 days each. They specified the particular life which was required for each particular cable, and if their cables did not come up to the life specified, the makers had to make up the difference. If the cable lasted more than the probable life, the profit was divided between the maker and the Tramway Co.

Fife.—Although some points have still to be adjusted between Lochgelly T.C. and the Tramway Co. as to the route of the proposed line to Lochore, it is expected that a start will be made with the extension in a few weeks. There will be a double line of rails to the end of the burgh boundary at Grainger Square.

Hull.—The tramway men recently sent to the Corporation Committee demands for a new time-table and for an advance of wages in certain sections. A deputation of the tramway men waited on the Committee, as a result of which the Committee drew up a revised time-table involving an additional cost of about £1,200. These terms have not been accepted, and at a mass meeting of the men it was decided to draw up a scheme for double shift duty with a reduction of hours, which the tramway manager states would represent an additional cost of £4,000 or £5,000. The executive of the Tramworkers' Union does not favour a stoppage, and thus there are hopes of the grievances being adjusted. At a meeting of the Tramway Committee on Wednesday, it was decided to defer the commencement of the revised time-table till after January 18th, which was the date proposed. The tramway men are asking for a reduction of hours from 54 to 48.

Japan.—One of the largest, if not the largest, railway bridges in the world is about to be built in Japan to give transit facilities to an electric railway and an electric tramway. The bridge is to be built across the Straits of Shimonoseki to the Island of Kiushu, and will be of a length of 1,140 metres, with a height of 51 metres above sea-level. It will thus allow the biggest ocean steamer to pass under it. It will be laid with a double line of rails, the one for the railway and the other for the street tramway. Its estimated cost is 15,000,000 yen. The plans will shortly be the subject of an international competition.—*Zeitschrift des Oest. Ingenieur und Architekten Vereins.*

Keighley.—The Corporation has included in its Parliamentary Bill for next Session application for powers for a scheme of electric tramway service embracing a large area, inclusive of many important manufacturing townships. The promoters of the project look with considerable favour on the success of the railless trolley systems on trial in Leeds and Bradford, and it is quite likely that if powers are obtained, the railless system will be adopted.

Leeds.—Two or three important matters have recently been engaging the attention of the Corporation Tramways Committee. It has been decided that the whole of the cars shall be fitted with side life-guards. A trial is to be given to the "queue" system of loading cars, and the place chosen for a commencement is near the Market Hall in Kirkgate. Although in Leeds there are, perhaps, none of the undignified "rushes" for tramcars, which are to be noticed in many other large cities and towns—such, for instance, as on the most-frequented route in Bradford—the passengers' difficulty in boarding cars is increased by the lack of order. The Traffic Sub-Committee has refused an application for permission to drivers and conductors to wear the badge of the Union on their uniforms.

Morley.—The approval by a B. of T. Inspector of the route from the centre of Morley to Leeds marks the completion of a large electric tramway extension scheme, which in its entirety connects Morley by tramway with Leeds, and almost, though not quite, with Bradford by way of Drighlington. The extensions which have just been completed by the Morley Corporation have been leased to the city of Leeds.

Newcastle-on-Tyne.—At a meeting of the Tramways Committee, on December 28th, the wages of all men who had completed eight years' service were increased by 1s. per week. On the motion of the chairman, the salary of the general manager was increased by £100, to be increased by a further £100 at the end of 12 months, which will eventually make his salary £1,000. A motion by Mr. Teags that the wages of the men in the sheds who had less than 25s. per week should be increased by 1s. a week, was lost.

Northampton.—The borough accountant has been directed to give formal notice of objection to the new valuation list, showing an increased assessment of the tramway undertaking in the borough, which has been deposited by the overseers.

Perth.—The Corporation Tramway Committee is to acquire meters for the cars with a view to checking the consumption of electrical energy.

Preston.—At the T.C. meeting on December 28th, the chairman of the Tramways Committee said some difficulty had been experienced in regard to securing borrowing powers for £3,000 to extend the car-shed and purchase three cars of a special build. The town clerk said his view, personally, was that they had no power to borrow this money because these particular borrowing powers were exhausted. Some provision would have to be made in an omnibus Bill. The chairman said that, under the circumstances, they had no option but to take the money from the reserve fund. Any further extensions would have to wait until they could obtain an Act of Parliament.

Rochdale.—The receipts on the Corporation tramways from the commencement of the financial year to December 16th totalled £52,386, or £6,950 more than in the corresponding period of last year. The car-miles run were 1,052,647, or 130,905 more than in the same period of 1910. All sections show increased takings, notably on the Bacup route, the advance being £4,350, due to the extension and through running.

Tramway Accident Inquiries.—In connection with the fatality caused by the running away of an L.C.C. car backwards down Lordship Lane, on November 29th last, the driver attributed the occurrence, in the first place, to a circuit-breaker coming out. An L.C.C. witness considered that owing to the fog the driver might not have realised at first that the car was moving backwards. In connection with the collision which occurred between two Rawtenstall cars on a hill in Accrington recently, Lieut.-Col. Druitt, of the B. of T., found that the cause of the accident was the fusing of a shunt-coil on one of the motors—regenerative control was in use on the car. The driver could not suspect the real cause of the trouble. Lieut.-Col. Druitt suggests that in order to prevent a repetition, such cars should only be run on level routes, or else precautions must be taken to prevent the fusing of shunt-coils. A footnote to this report, by Mr. A. P. Trotter (B. of T.), is as follows:—"The termination of a shunt-winding in a fine wire is a defect of construction. Both at the inner and at the outer end of the fine wire a stout wire strong enough to stand handling and cleaning should be carefully jointed. This stout wire should be wound three or four times round the magnet before bringing out. It is not likely that the shunt-wire was fused, unless part of the shunt-winding was short-circuited, or unless very high voltage had been produced by regeneration. The wire is likely to corrode where it leaves the magnet, and may have sparked on breaking, and may thus have shown signs of fusion."

U.S.A.—Plans and surveys are being made by the Pennsylvania Railroad for improvements of the Pittsburg terminals to cost $50,000,000. These plans call for the electrification of the main line between the Union station in Pittsburg and Pitcairn, 15 miles east of that city, the terminus for local trains. Subways will be built to abolish grade crossings at many points; yards will be extended and electric locomotives and new rolling stock will be added.—*Electric Traction Weekly.*

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Commonwealth Parliament has voted a sum of £600,000 to be paid into a trust fund on account of telegraph and telephone works. It was explained that experience showed that much money was lost through lack of continuity in work, and the fund would be expended as required.

Austria.—Considerable expenditure is contemplated by the Austrian Post and Telegraph Department. In the Budget for 1912, 9,000,000 kronen were ear-marked for telephone extension. A further 20,000,000 kronen for postal purposes is also to be spent, about 11,000,000 of which is allocated to telephone and telegraph extensions, &c.—*Der Elektrotechniker.*

Cable Rates.—In a notice announcing the reduction on January 1st of cable rates to the British Dominions and the United States to half the usual rates, for telegrams in plain language, subject to a delay of 24 hours, as previously explained, the Postmaster-General includes India and South Africa, which were excluded from the preliminary announcement.

The Commercial Cable Co. has also announced a reduction on similar lines to North America and Australasia.

Germany.—From January 1st the German Post Office accepts plain-language telegrams at half rates for the German Colonies, the United States, China, and many British Colonies subject to a delay of up to 24 hours.

Night Telegraph Letters.—The experimental service between London and Aberdeen and Belfast came into operation on Monday last. The charge is 6d. for 36 words, and ½d. for every three words beyond 36. Telegrams must be handed in (prepaid) at the head offices, or telephoned or posted to those offices. If they are posted, the envelopes must bear only the words "Telegraph Letter."

Postal Employés' Grievances.—The Committee of Inquiry promised by the Postmaster-General will sit in the spring of this year, and will consider proposals relating to wages (involving an increased expenditure of about a million sterling) and hours of labour. The last revision took place in 1908, and was expected to hold good for many years. It is stated that London telegraphists demand a maximum salary of £230 a year, instead of £161 as at present; provincial telegraphists ask for £200, and women in London and the provinces claim £130 and £120 a year respectively. Engineering and stores employés demand to be put on the established staff, and to be employed continuously.

Radiotelegraphic Conference.—The British Government has announced that the Conference will meet in London on June 4th, 1912.—*Journal Télégraphique.*

Radiotelegraphic Convention.—The Belgian Government has adhered to the Convention on behalf of the Congo State, as from January 1st, 1912.—*Journal Télégraphique.*

Russia.—The Government has decided to erect wireless stations on the coasts of the White Sea and Kara Sea for the assistance of ships bound for the mouths of the Obi and Yenisei, on Vaigatch Island, at Vaidaran Bay, and on the Ugorski Shar Strait. *Board of Trade Journal.*

Uruguay.—The Government has been empowered to spend a sum of nearly 2,000,000 fr. on the improvement of the State telegraph network.—*Elektrotechnik und Maschinenbau.*

The Telephone Transfer.—The transfer of the undertaking of the National Telephone Co. to the State took place without in any way affecting the existing service or organisation of the business, except as regards the head officials, to the number of 11. The transaction involved the transfer of 1,578 exchanges, and 549,976 stations, served by 18,000 employés. A sum of £3,000,000 is to be paid to the company on account. The Postmaster-General addressed a letter of welcome to the employés, pointing out the advantages they would derive from the change, and expressing his intention to secure equality of treatment between transferred and existing officers so far as was possible. A valedictory letter was also issued by Mr. G. Franklin to the company's staff, commending the zeal and fidelity of the employés and their loyalty to the board of directors, and offering them his personal thanks and sincere wishes for their prosperity in the service of the State. On Saturday night the Metropolitan day staff assembled at the Holborn Restaurant to celebrate the occasion by a dinner, dance and concert. Over 1,000 were present, about half the number being female operators. Mr. C. B. Clay, superintendent of the Metropolitan district, presided at the dinner, and Mr. G. Franklin, president of the company, was present. Similar functions took place at other centres.

A meeting of the company will take place on January 9th to pass the necessary resolutions for the liquidation of the concern and the payment of the debenture-holders, followed by an extraordinary general meeting to appoint Mr. Franklin liquidator, and to continue the powers of the directors in dealing with the purchase by the Post Office. The inventory of the company's assets, which has been in progress for many months, is approaching completion, and it is expected that the company's statement of claim will be presented to the Postmaster-General early this year. Almost certainly the matter will have to be taken before the Railway and Canal Commission for the final settlement of terms.

At a meeting of the Glasgow employés of the company on Thursday last week, a resolution was passed protesting against the conditions of service under the classification proposed by the Postmaster-General.

Last week the subscribers connected with the National "Westminster" exchange were transferred to the Post Office "Victoria" Exchange, and those on the "Harlesden" Exchange to "Willesden." The "Bank" subscribers will shortly be transferred to the new "Avenue" exchange, the equipment of which presents some novel features tending to the avoidance of delay in answering calls. Several other National exchanges have been closed.

Paris-Madrid.—On Monday the telephone service between Paris and Madrid was successfully inaugurated. The distance is about 1,000 miles.

Wireless Telegraphy.—The new station at Port Said, in connection with Lloyd's monopoly of wireless telegraphy in Egypt, has been brought into use.

The first case under the new United States law requiring passenger steamers to carry a wireless outfit is now pending, the ss. *Templemore* being charged with a breach of the regulation.

The station on Spitzbergen is now completed, and messages have been exchanged with Poldhu, in Cornwall, and with Ingoe, in Norway.

Wireless Telephony.—A German engineer named F. Kiebitz is reported to have effected important improvements in wireless telephony by means of earth waves of high frequency, and it is stated that the Western Electric Co. has developed a water-cooled microphone for use in wireless telephony, which can deal with much larger currents than the ordinary type.

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-under-Lyne.—January 24th. Three Lancashire boilers and two 1,500-KW. turbo-alternators, for the Corporation. See "Official Notices" to-day.

Australia.—N.S.W. GOVERNMENT RAILWAYS.—January 22nd.—Supply and erection at the White Bay power house, Sydney, of eight water-tube boilers, with superheaters, economisers and mechanical stokers. January 29th.—A 25-KW. booster set. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.

January 9th.—Accumulators, booster, switchboard and accessories, for the Subiaco Council. Town Clerk's office. Deposit of £100.

MELBOURNE.—January 9th. Three tons of bare hard-drawn copper cable, for the City Council. See "Official Notices" December 22nd.

February 7th.—The Prahran and Malvern Tramways Trust, Melbourne, are inviting tenders for 1,272 tons of tramway rails. Specifications and forms of tender, £2 2s. (returnable), from J. Coates & Co., Ltd., Suffolk House, Laurence Pountney Hill, London, E.C.

February 19th.—Wire-testing machine, for the Postmaster-General's Department in Tasmania. See "Official Notices" to-day

Belgium.—January 18th. The municipal authorities of St. Gilles-lez-Bruxelles are inviting tenders for the supply and installation of two electric motors at the Baths, 38, Rue de la Perche, St. Gilles.

Birmingham.—January 8th. (*a*) Supply, delivery and erection of 50 electric tramway cars; (*b*) 1,700 tons of improved steel girder rails, and 3,500 pairs of fishplates. Mr. A. Baker, general manager, Tramway Offices, Corporation Street, Birmingham.

Burnley.—Lighting battery at the Workhouse, for the Guardians. See "Official Notices" to-day.

Croydon.—January 29th. Mixed-pressure turbine plant, for the Corporation. See "Official Notices" to-day.

Dartford.—January 23rd. One high-speed vertical uniflow engine, tandem generators and three-wire balancer, three superheaters and extensions to pipework, switchboard and electrically-driven centrifugal pump, for the U.D.C. See "Official Notices" December 15th.

Dublin.—January 30th. Dublin Port and Docks Board. Two 4-ton electric portal wharf cranes. Specification, £1 returnable, from Sir J. P. Griffith, Engineer to the Board, East Wall, Dublin.

Grimsby.—January 15th. Metal-filament lamps for a year, for the Corporation. See "Official Notices" to-day.

Hornsey.—January 11th. One steam dynamo set (either reciprocating or turbine), for the T.C. See "Official Notices" December 8th.

London.—HAMMERSMITH.—January 10th. Arc lamps for the B.C. See "Official Notices" December 29th.

ISLINGTON.—February 2nd. Electrical and engineers' stores for a year, for the B.C. See "Official Notices" to-day.

Manchester.—January 9th. (*a*) Steel girder tramway rails; (*b*) steel tie-bars for tramway rails. For (*a*) deposit of £1 1s. required. Specifications and forms of tender from Mr. J. M. McElroy, general manager, Corporation Tramways.

New Zealand.—March 7th. Napier Corporation. (1) Permanent way, overhead work and supply mains; (2) power station, car-shed and repair-shop equipments; (3) rolling stock. Deposit 2½ per cent. Specifications can be seen at the Board of Trade Commercial Intelligence Branch in London.

Nuneaton.—January 24th. One 500-KW. mixed-pressure turbo-generator, with condensing plant, pipework, &c., for the Corporation. See "Official Notices" to-day.

Plymouth.—January 20th. Stores for a year, for the Corporation Electricity and Street Lighting Departments. See "Official Notices" to-day.

Prague.—January 31st. Supply of two turbo-generators, of a normal capacity of 3,600 KW., with accessories. Particulars, plans, &c., from Städtischen Kanzlei der Elektricitätscentrale, Prague VII, and tenders to Haupteinreichungsprotokolle der Electrischen Unternehmungen, Altstädter Markthalle, Prague.

Radcliffe.—January 13th. Electrically-driven centrifugal or turbine pump for the U.D.C.'s sewage disposal works. W. L. Rothwell, surveyor.

Rotherham.—January 10th. One 500-KW. rotary converter, for the Corporation. See "Official Notices" December 29th.

(Continued on page 24.)

ELECTRICITY SUPPLY AT KEIGHLEY.

BY HARRY WEBBER, A.M.I.E.E., Borough Electrical Engineer.

ELECTRICAL driving in textile mills can now be said to have passed beyond the experimental stage, and it is the purpose of this article to give an outline of what has recently taken place in this direction at Keighley, with special reference to the worsted trade.

Perhaps one of the most interesting examples in this country of an electrically-driven weaving shed is to be found at the West Lane Mills of Messrs. J. H. Binns & Co., everything being driven by three-phase motors, whilst the whole mill is lit throughout by electricity, the supply being obtained from the public mains of the Corporation.

This firm only manufactures the highest class of goods such as suitings and best quality dress material. There are some 130 looms, each driven by a separate motor; the "jacquard" looms which are used for material with fancy patterns are fitted with motors of 1½ B.H.P., but the looms for the plain work only require from ¾ to 1 B.H.P.

The whole mill is scrupulously clean and well ventilated, and to pay a visit there after coming out from one of the old type, with steam power and belt drive, fully convinces everybody that, from the workers' point of view, electrical driving is ideal.

Messrs. Binns removed from an old steam-driven mill into new premises, so that they have had an opportunity to compare the results obtained with both methods of working, and they have no reason to regret their decision in favour of electricity.

A supply of electrical energy at cheap rates gives power users a much greater latitude in the choice of a site for new works, and this fact alone will have great influence with manufacturers in deciding whether to take a supply from the public mains or to install their own plant.

In Keighley, several firms who own large mills let these out on what is termed "room and power." The charge varies, but for spinning, the power is sold at from 3s. to 4s. per annum per spindle, according to the type, whether it is a "cap" or a "flier." An average spinning frame takes 5 to 6 H.P. to drive it, and the price for power is generally about £3 10s. to £4 per I.H.P. per annum.

As will be seen from the above figures, a public supply must be offered at very low rates in order to secure this particular class of customer. However, there is one firm in Keighley who are taking a supply for a portion of their mills (let out in the above manner) from the public supply mains of the Corporation. For worsted spinning of this description, the load factor is very high, reaching 80 to 85 per cent. during the working day from 6 a.m. until 5.30 p.m. I find that, in order to give satisfaction in both weaving and spinning sheds, the frequency must be kept within a quarter of a period on either side of the declared number of cycles per second.

At the beginning of the three-phase extra-high-pressure supply in Keighley a motor-generator was used, driven from the existing D.C. bus-bars at 460 volts, and producing a three-phase 6,600-volt supply on the high-tension feeders. This arrangement, however, is not satisfactory, as a motor-generator driven in this manner is far too sensitive, and I found that even quite small squirrel-cage motors without graduated starters caused most serious fluctuations in the frequency, which affected the looms more particularly.

Naturally, manufacturers desire to produce as much work from their machinery as possible, and the looms are set to work at the maximum speed beyond which the smaller parts are liable to break, so that only a slight increase of speed is necessary to create a considerable loss in a weaving shed. On the other hand, most of the weavers are employed on the piece-work system, and they soon complain if the machinery is running slow.

The writer has no hesitation in saying that wherever a supply is being given, or in contemplation, with motor-generators in a similar manner to that described above, it will not give satisfaction if the demand is for driving textile machinery.

Immediately the supply was available from turbines the constant series of complaints ceased at once. Owing to various adjustments required by the new plant, it was necessary to revert to the motor-generator occasionally, but in each instance the complaints began to re-appear on the first day that the change was made.

An astonishing figure would result if it were possible to add up the total amount of power wasted in driving some of the more antiquated and complicated mills in Lancashire and Yorkshire alone. There are still plenty of mills working to-day with cross-shafts and bevelled gearing, whilst the maze of belting is bewildering to the eye.

To quote some actual figures taken recently off a length of shafting with all the belts on the loose pulleys, the shafting alone took 5 H.P. to drive it, and when all the work which was done from this line was set in motion, it was found that the consumption of power only reached a little over 8 H.P. This, of course, is an extreme case, but it is quite usual to find the shafting taking 25 per cent. of the total power required.

The writer has found, when negotiating with prospective consumers, that they will stick to the indicated horse-power, as shown on their possibly antiquated engine, and divide that figure into the amount of money spent by them in order to arrive at a comparison between the present cost, and what it would be if taking energy at a fixed rate per unit (covering all charges) from a public supply. When it is realised that possibly over 50 per cent. of the horse-power (as shown on an indicator diagram) is being wasted in one direction or another, which would be entirely eliminated by a properly thought-out electrical scheme of driving, it will be obvious that this method of comparison is not a fair one.

There are plenty of millowners to-day waiting to let other people take the risk of what they consider an experiment with electrical driving when energy is being taken from a public source, and I am constantly being approached by people who state that they have machinery which requires, say, for example, 250 H.P. to drive it (as shown by their indicator cards), and ask whether the Corporation would guarantee to run this for a lump sum per annum.

This clearly shows that millowners appreciate the beauty of electrical driving, but they want to be on the safe side, and when you have to tell them what 1 H.P. would cost per annum on the lowest rate charged for electrical energy, estimated on the working hours and the load factor of the mill in question, it generally results in their saying that they can do it themselves for at least 20 per cent. less cost. It requires a lot of talking to persuade a man who has always relied on an indicator diagram that this method does not represent the actual amount of useful work that is being done in his mill.

It is a pity in some senses that an offer cannot be made to drive mills of this description for a lump sum per annum, as I am certain that a great deal more business could be secured in this way at a profit.

The rates in force in Keighley at the present time are very attractive, considering the smallness of the undertaking. Extra-high-pressure three-phase energy can be obtained in bulk at £3 per KW. of maximum demand, plus ¼d. per unit, the account being paid monthly, and subject to a 5 per cent. discount; a condition attached to this extremely cheap rate is that a consumer must supply a proper fireproof house, and build a suitable cubicle of stoneware for the reception of the Corporation's meter equipment and automatic knock-out switch, and also supply his own transformers.

The energy is metered on the high-pressure side, and a consumer may use it in any manner he thinks fit, but with certain limits as to the size of squirrel-cage motors installed without graduated starting switches.

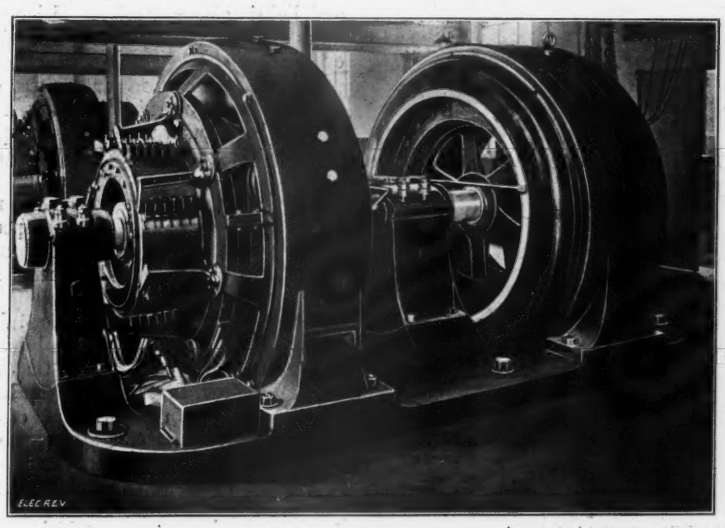
The cables are looped into the premises, and thus effect a duplicate arrangement, the meter and switch handle being mounted on a panel outside the transformer house (which is kept under lock and key), thus obviating any reason for continually going in and out of the high-pressure chamber. Six small sub-stations of this description are now equipped, and they give every satisfaction.

Besides doing a large business in connection with the worsted trade, Keighley has a great variety of other thriving industries, some of which only require about 40 H.P. They are scattered all over the area of supply, and consequently the only system available for these very desirable small-power users is the old direct-current network.

Several methods of charging were tried, but without success; the sliding scale based on quantity did not come out cheap enough, and the hourly contract system resulted in such a variety of prices per unit, that it had to be abandoned owing to the bad feeling created. It was decided to adopt a method which has proved a great success, and is as follows: — Providing a consumer signs a five years' agreement, and guarantees a minimum payment of £40 per annum, a flat rate of $\frac{3}{4}$d. per unit is charged without any restricted hours.

This method has become very popular, and fresh applications are coming in every week. Owing to the large diversity factor due to a number of small power users, the load factor as shown on the daily load chart is steadily improving, and at the present rate of increase, the number of units sold this year will be double what it was last year.

Having briefly described how the use of electrical energy is developing amongst all grades of power consumers, it will not be out of place to outline the class of plant which has been installed to meet the demand.



500-KW. MOTOR-GENERATOR PLANT, KEIGHLEY.

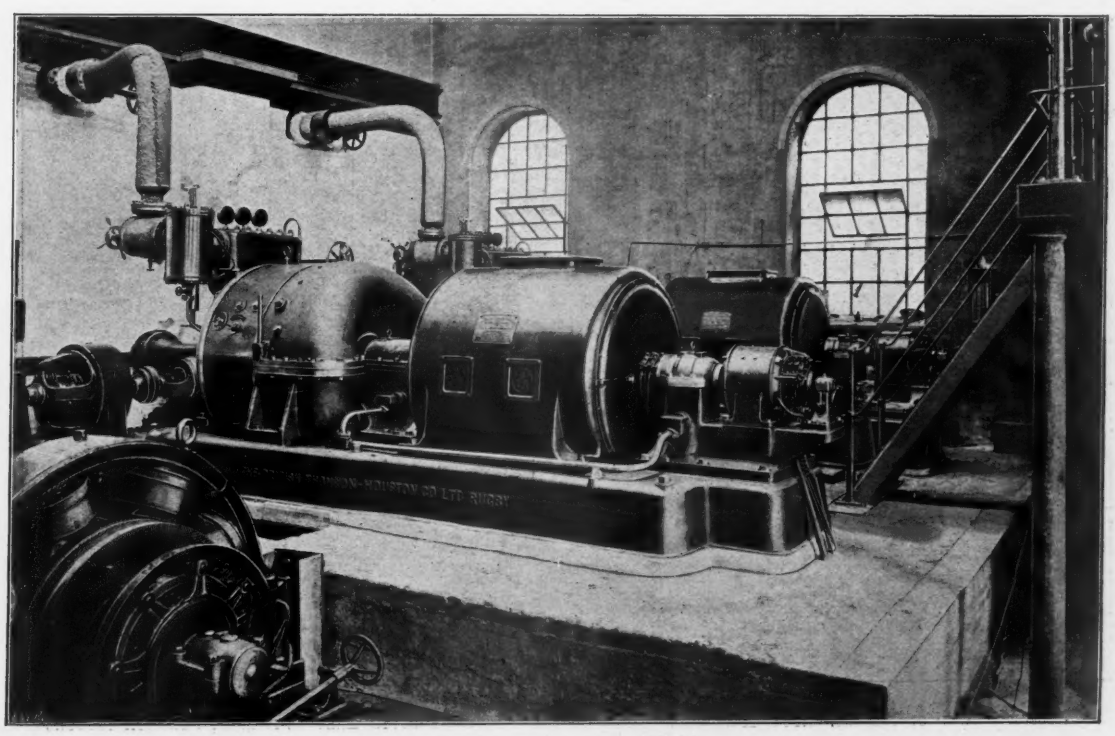
turbo-alternators running at 3,000 revolutions per minute, each set having its own condenser, which is of the Körting multi-jet ejector type. The steam for these generators is produced by two Babcock & Wilcox water-tube boilers, of their well-known standard land type.

The boilers are fitted with integral superheaters, and patent mechanical chain grate stokers, the heating surface of each boiler being 1,560 sq. ft., of the superheater 990 sq. ft., and the chain grate area 108 sq. ft. Each boiler is capable of evaporating 20,000 lb. of water per hour under normal conditions, but it is possible to increase this amount to 25,000 lb. for short periods without unduly forcing the boiler to any dangerous extent.

A new chimney 150 ft. high has been erected, and the necessary flues constructed of sufficient area to effectively deal with the gases from four other boilers similar to the two installed.

A first instalment of economiser tubes is fitted, and available space for further sections provided.

A pair of double-acting vertical feed pumps, each capable of delivering 2,500 gallons of water per hour against 165 lb.



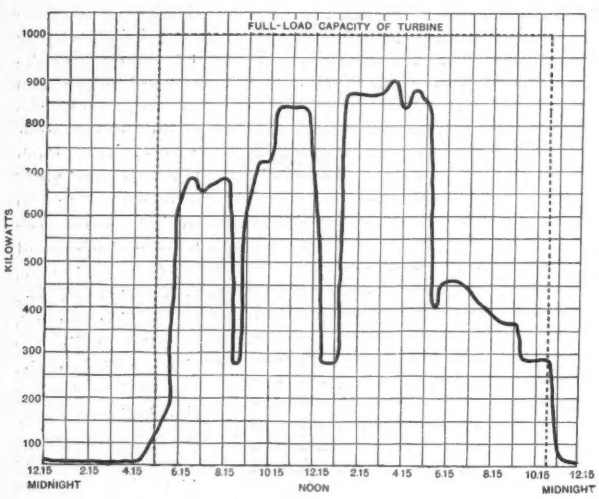
INTERIOR OF THE KEIGHLEY POWER STATION, SHOWING B.T.-H. TURBO-ALTERNATORS.

In January, 1910, all negotiations were finally settled and everything was in order to proceed with the installation of a complete extra-high-tension three-phase power plant, but it was not until the August following that any actual construction work was commenced.

The complete installation consists of two 1,000-KW. Curtis pressure, are included in the boiler house equipment. These pumps were made by a firm whose name is not generally known to central station engineers, namely, F. Friedenthal & Son, of Preston. Although the pumps caused some slight trouble to begin with, they are working very satisfactorily, considering the small initial cost.

F

The British Thomson-Houston Co., Ltd., were the main contractors for the whole of the generating plant, and also supplied one of their well-known extra-high-tension remote-control switchboards, the high-tension portion being entirely enclosed with either expanded metal grids or sheet-iron doors, and so arranged that anybody can walk all round both back and front without taking any dangerous



Load Curve, December 7th, 1911.

risks whatever. It was decided not to extend the building for the reception of this extra plant, and the result is that it is somewhat crowded.

In order to give an immediate load for one turbine, two motor-generators have been purchased, one of 500 kw. capacity and the other of 300 kw. By this means, the existing demand, namely, the traction load and the d.c. lighting and small-power load, can be effectively dealt with at a lower cost per unit generated than would have been the case if this portion of the demand had still been supplied from the old existing plant driven by small reciprocating engines.

The first turbine was put on commercial load during November, 1910, but owing to late delivery of switchgear and various other parts of the equipment, the supply last winter had to be carried out under very inefficient conditions. The turbine was running with little more than one-quarter load, and all the old plant had to be run as well. At the present time, one turbine is fully loaded up, and runs from 4 a.m. until 12 p.m. generating the entire output with the exception of about one hour when the power and lighting loads overlap. I have found the Curtis turbines (which in this case are of the horizontal type) to be in every way satisfactory.

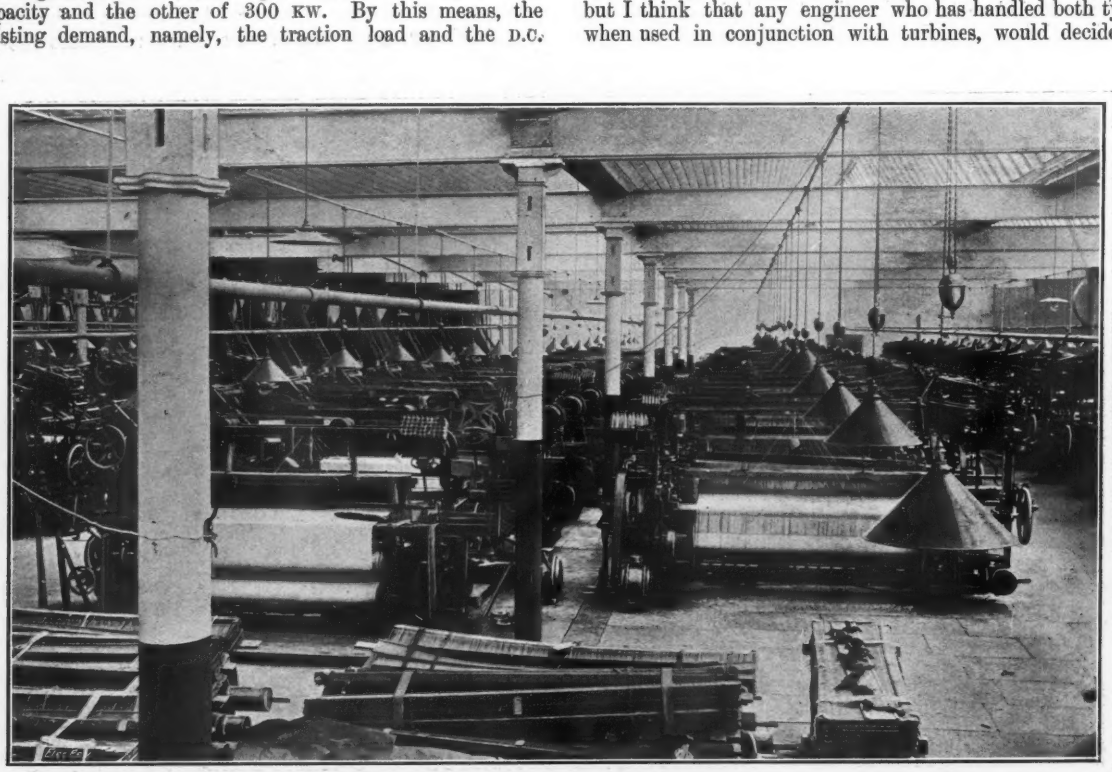
There is a Tirrill regulator fitted on the switchboard, but owing to good governing and a remarkably steady load, it has not been found necessary to couple this up. There have been the usual small troubles incidental to all new machinery, but these have been overcome.

Respecting the Körting condensers, they have fully come up to their guarantee for the specified vacuum, namely, 28 in. on full load, with the temperature of inlet water not exceeding 65°, and the barometer standing at 30 in. of mercury.

With a combination of water-tube boilers and turbines, where there is no internal lubrication, the writer would prefer a surface condenser, so that the hot distilled water discharged from the air pump can be returned to the boilers direct. With an installation of this description, providing that glands and safety valves are not leaking, it requires very little make up water to obtain the whole of the feed necessary to keep a correct water level in the boilers.

At Keighley, the water supply is taken from an extremely dirty stream, and with an ejector type of condenser where the circulating water mixes with the condensed steam, the pure distilled water is necessarily discharged into the river and dirty river water used for feeding the boilers.

Naturally, opinions differ on this point, and there is no doubt that the first cost of an ejector condenser equipment is considerably lower than a surface plant of a similar capacity, but I think that any engineer who has handled both types when used in conjunction with turbines, would decide in favour of the surface condenser, owing to the fact that it eliminates two-thirds of his boiler house troubles. If you add the costs of purifying and softening plant to the cost of the ejector condensers, I think the first cost would then be in favour of a surface equipment. At Keighley, owing to the extremely cold water available, it is possible to maintain



Weaving Shed of Messrs. Binns, Keighley, Containing 150 Looms Individually Driven by Schorch Motors on the Corporation Supply.

a vacuum within 1 in. of the barometer up to approximately full load of the turbines.

Before concluding the description of plant installed, I should like to mention the type of extra-high-tension cables used, and the method of laying them.

A start was made with duplicate feeders through the most promising district from an industrial aspect. These cables are three-core, paper-insulated, and-lead covered with a complete copper earth-sheet immediately beneath the surface of the lead. Each core is ·15 sq. in. sectional area, and they are drawn into four-way Sykes ducts supplied by the Albion Clay Co.

The Western Electric Co. were the contractors for the complete contract, including jointing, and they gave a three years' maintenance on the work. Some smaller feeders, the cores being ·05 sectional area, have since been laid by the same firm. All the feeders are protected by automatic knock-out switches, with a time-limit for overload, but instantaneous release should a large earth develop.

The Keighley Corporation is to be congratulated upon now possessing the nucleus of what promises to become a really important power station for the town and district, and, even at the present time, a complete failure in the supply would affect nearly every class of industry.

Besides textile mills and tramways, a supply is given for the following power purposes :—The manufacture of looms, spinning frames, machine tools, castings of every description, boots and shoes, electrical apparatus, hosiery, washing machines, sewing machines, cabinet making and joinery, stone sawing and building work, laundry work, and a large variety of smaller domestic commodities.

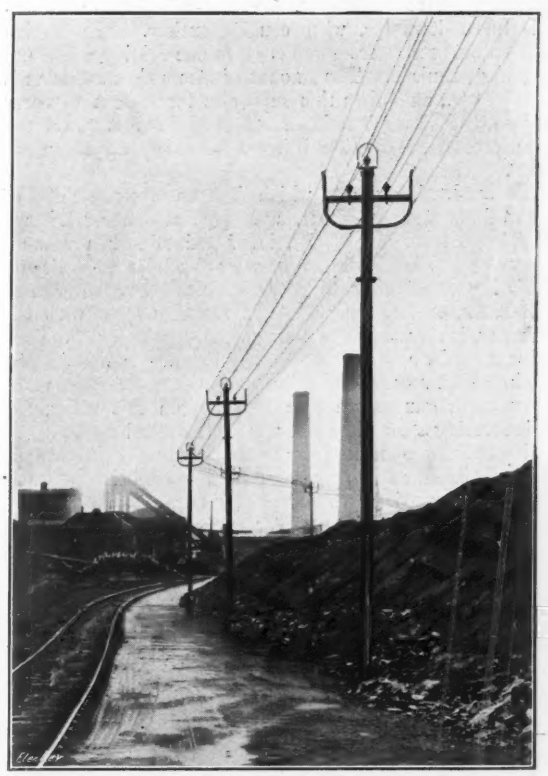
In conclusion, taking into consideration that the population only amounts to about 45,000 inhabitants, the adoption of electricity is remarkable, and it seems likely to continue.

The electricity department has to fight against a gas department, also owned by the Corporation, who are in the happy position of having turned the corner many years ago, and can consequently not only offer gas at very low prices, but also hand over a substantial profit towards the relief of the rates every year, and it is the hope of equalling these good results in the near future which is partly responsible for the energetic policy of business getting which has been adopted.

The illustrations show the new turbines in course of erection, the interior of Messrs. Binns's weaving shed, the large motor-generator and a load diagram taken quite recently.

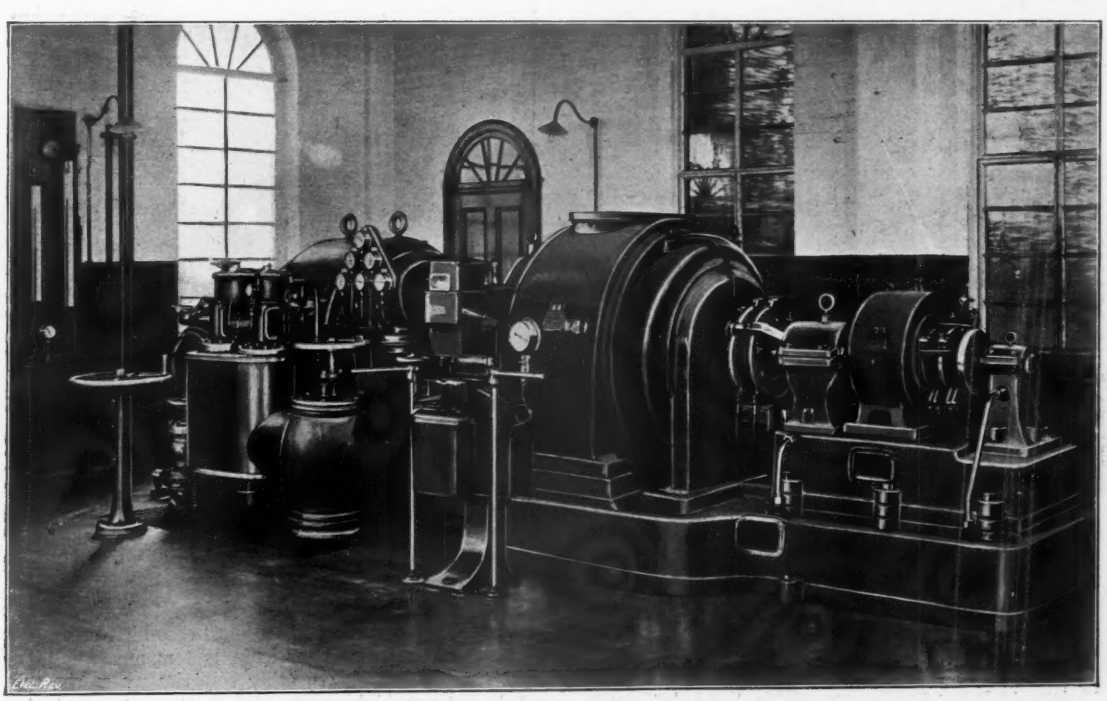
THE ELECTRICAL EQUIPMENT OF THE CRAIGHEAD AND BOTHWELL CASTLE COLLIERIES.

THESE collieries have been established about 30 years, and are, therefore, amongst the oldest in Scotland. They are



6,000-VOLT OVERHEAD TRANSMISSION LINE, CRAIGHEAD.

situated at Bothwell Castle, near Glasgow, and are owned by Messrs. William Baird & Co., one of the first firms in Scotland to use electricity for underground mining work.



WESTINGHOUSE 300-KW. MIXED PRESSURE IMPULSE TURBO-ALTERNATOR, BOTHWELL CASTLE COLLIERY.

Their experience has been such that they are one of its firmest advocates at the present time.

The power house is at present situated at the Bothwell Castle Colliery ; a portion of the output is transmitted at a pressure of 2,200 volts to Craighead Colliery, about a mile away, and may, at a later date, be transmitted to other collieries in the same way.

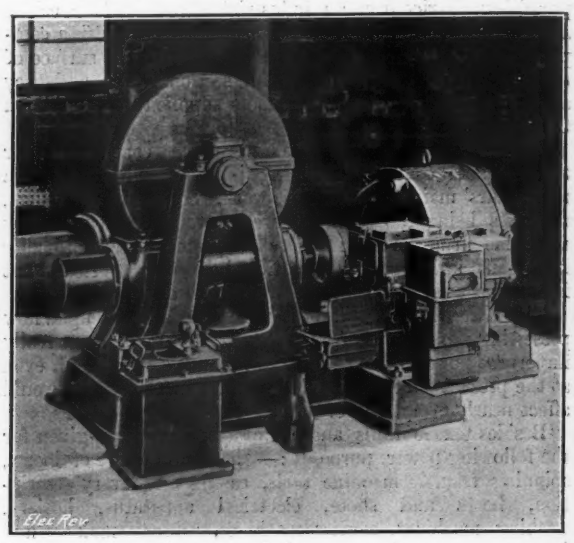
The power unit at present consists of a mixed-pressure straight-flow turbine of the Westinghouse impulse type, direct coupled to a 300-KW. 500-550-volt three-phase 50-cycle turbo-alternator, with coupled exciter. The turbine takes exhaust steam from two engines, one driving a fan, and the other a haulage. The amount of steam thus available is 115-180 KW., and when this supply is insufficient to carry the load, live steam is taken from the boilers at 60 lb. per sq. in. pressure, regulation being effected by an automatic device.

The condensing plant, which has an average duty of 12,000 lb. of steam per hour, is of the Westinghouse-Leblanc multiple jet type, and is capable of maintaining a vacuum of between 27½ and 28 in. of mercury at full load, the air and circulating pump being driven by a squirrel-cage motor rated at 47 B.H.P. at 720 R.P.M. This motor, which, with the condenser, is situated in the basement, is controlled from the engine room by a mining type control pillar comprising oil switch, oil-immersed controller, and ammeter ; the water and vacuum gauges are also mounted on this pillar, the whole forming a complete and accessible control system.

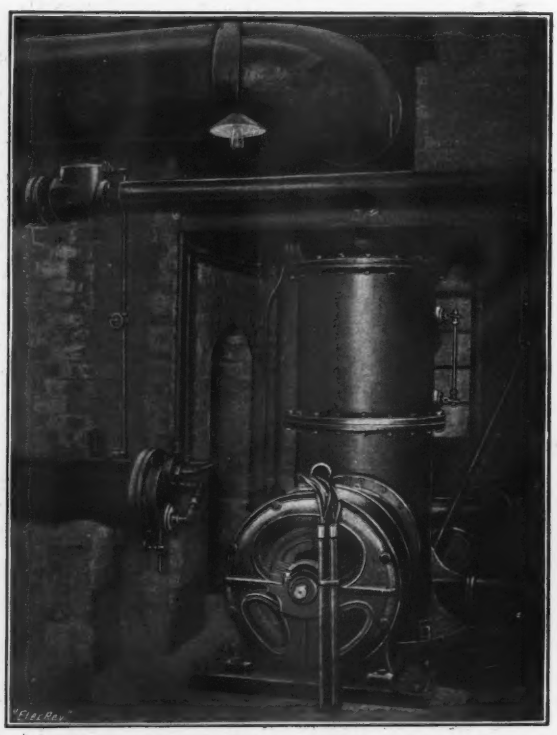
The current generated is used at terminal pressure at Bothwell Castle, on motors both above and below ground, but is transformed to 2,200 volts for transmission to Craighead. The line is designed for working later at a pressure of 6,600 volts, but as all the electrical machinery has not yet been erected, the lower voltage is quite sufficient for the small amount of power at present being transmitted.

A six-panel black enamelled slate switchboard controls the generator and outgoing feeders, and comprises one high-pressure and five low-pressure panels.

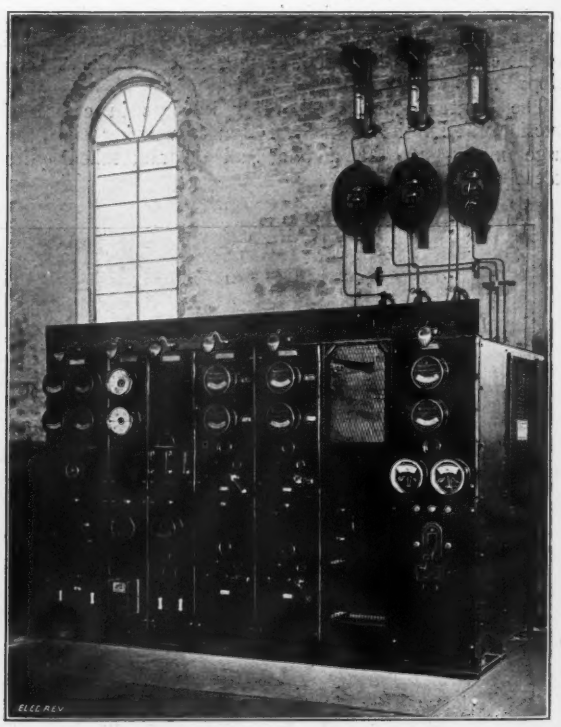
Current is taken from the high-pressure bus-bars and led underground by a three-core, paper-insulated, lead-covered cable to a point clear of the Bothwell Castle Works, and thence by an overhead aluminium line, supported at intervals of about 50 yd. on wooden poles to Craighead, where it is stepped down to 500 volts for use. This line is led across country over roads and through woods, finally crossing the River Clyde at a point where it is 210 ft. wide. The line was tested at 11,000 volts to meet the Board of Trade requirements, and was found perfectly satisfactory in every way. It is composed of three aluminium cables, each consisting of three No. 10 S.W.G. wires having no joint from end to end, fastened to brown porcelain insulators (tested to 22,000 volts) by aluminium clips. At the Clyde, steel guard wires are fixed underneath the lines for the double purpose of taking the pull, and preventing the lines from falling in the event of a break. A high-pressure telephone line connects the two mines, and is mounted on the same poles as the power lines.



VARIABLE SPEED SQUIRREL-CAGE MOTOR AND WORM DRIVE FOR HAULAGE, BOTHWELL CASTLE COLLIERY.



WESTINGHOUSE-LEBLANC CONDENSING PLANT



MAIN SWITCHBOARD, POWER STATION.

Although the pressure is stepped down to 500 volts for use at Craighead, it should be mentioned that high-pressure current will be used direct on large motors, and will also be used for transmission to other collieries where the supply will be a direct high-pressure one to the motors. At Bothwell, Nos. 1 and 2 Pits, 500-volt A.C. only is used. At

present there are five motors in use at the former and seven at the latter, all of the squirrel-cage type. One of these is a 7-H.P. motor used for driving a winding equipment for hauling men up a 25-ft. blind pit.

At the Bothwell Castle and Craighead Pits some very neat haulages are in use, motive power being furnished by two-speed squirrel-cage motors operated by oil-immersed controllers and mining-type oil switches. The drive is by worm gear, and the motors, which are rated at 10-5-H.P., run at a speed of 970-480 R.P.M. This variation is effected by a controller which makes the different connections of the stator winding, so as to vary the number of poles.

This plant was installed under the supervision of Messrs. Stevenson & McGuffie, of Glasgow, consulting engineers to Messrs. William Baird, the British Westinghouse Co. being responsible for the entire electrical equipment.

FAILURES OF STEEL PLATES.

The memorandum of the chief engineer of the Manchester Steam Users' Association for the year 1910 contains information of vital importance upon those failures of steel plates and angles to which it is usual to allot the word mysterious. "Mysterious" in all science and art really means that there are gaps in our knowledge; just as the gaps in the orderly arrangement of the elements in Mendeleef's theory may be held to indicate, and already have indicated, the existence of elements not yet isolated, so do the mysterious failures of steel indicate the presence of some undetected influence. Phosphorus and sulphur have long been tracked down. The influence of carbon, manganese, tungsten, chromium, and other metals has been fairly well mapped out. But more recently gaseous elements have become suspect, and this report has gathered together so many examples of bad steel and good steel that the badness and goodness can be set alongside of the new factor, nitrogen, to which seems fairly to have been brought home the crime of being a prime agent of unreliable qualities.

An investigation of both German and British steels made by basic and acid processes with open-hearth and Bessemer furnaces, discloses that if the percentage of phosphorus in a steel be added to five times the percentage of nitrogen in the sample, the resulting sum will form a sort of datum from which may be inferred the reliableness of the steel in question. The sum will be more or less than 0·080. If this figure is exceeded, the steel is over the danger line, and becomes worse as the figure is further departed from; if less than 0·080, the safety of the steel becomes greater as the sum grows less. Nitrogen makes for tenacity, and we are not told that a little of it is not good. But in no case should the figure 0·080, as above derived, be exceeded. The report goes on to show that of a number of safe and unsafe steels, those which were really the *worst* passed *best* the ordinary mechanical tests, and it becomes important that both chemical and mechanical tests should combine to indicate reliableness.

It is really an art, this mechanical testing of steel plates, for it is found that if a plate is thicker than $\frac{5}{8}$ in., the edges of a test piece must be planed, or the pieces will break with the least bending, no matter if the material is good or bad. But again, if the thickness is under $\frac{5}{8}$ in., and the edges are planed, they may be bent nearly double before breaking, no matter whether good or bad. Thus, an unreliable steel will pass a very severe test by bending, and may be put into a boiler and fail on hydraulic test—or subsequently, which may mean disaster.

We need not follow the report into the question of ageing further than to say that samples laid aside and tested appear to get worse if bad, and to improve if good.

A rather important point disclosed by a series of blue heat tests was that generally the good—*i.e.*, sound—steels best endured working at a blue heat, and bad steels did badly. A moral to be drawn so far is that safe tenacity is obtained by carbon and silicon, which are not factors of unreliability, and that tenacity obtained by phosphorus, and especially by nitrogen, is obtained at the expense of safety. Thus one steel might safely be worked at 9·4 tons where a nitrogen steel was doubtful at 4·1 tons. Yet present testing would condemn the strong, safe steel, and encourage the weaker and shifty material. These facts, and others given in this memorandum, are most valuable, and have a special interest for power station men. A nitrogen steel or a phosphoric steel plate might slip undetected into a boiler shell. No doubt many have done so, and some have produced disaster. The man in charge of a power station should never take the stand of Midshipman Easy's nurse and lightly regard a small failure in a plate. If a steel plate cracks along a line but an inch in length, this line may suddenly run round the circle of a drum end and convert the drum into a steam gun or rocket. No trust can be placed in bad steel. Bad iron was much safer, for one knew the extent of its badness and discounted its weakness. Strong steel gains no safety from its strength, and if unreliable in quality fails badly by reason of its very virtue of homogeneity.

INITIAL CONDENSATION IN STEAM CYLINDERS.

It has been necessary several times to comment upon the theory of a Manchester school regarding the missing quantity of steam as shown by the indicator at the beginning and end of the stroke. Clark, Hirn and others seem to us to have given satisfactory proofs of this phenomenon, and, rightly, to have explained it as an effect of cylinder condensation. We believe Hirn's experiments were made with pistons and valves in good and tight order. The new school would have us believe that there is little or no cylinder condensation, but a great deal of leakage, and this view has again been put forward by Prof. Mellanby, who is a faithful follower of Prof. Nicholson.

Prof. Mellanby read his latest paper before the Institution of Engineers and Shipbuilders of Scotland. His reasoning is based on assumptions made from thermometer readings taken from instruments placed midway up the cylinder wall. From the apex of this pyramid we are asked to build up to a wide spreading base. Perhaps the most ingenious twisting of observed facts to fit a preconceived conclusion is the use of the reduced evaporation in a jacketed cylinder to show that there is least evaporation in the hotter cylinder. A jacket, if it serves its purpose, will reduce the amount of condensation, and there must be less water to evaporate on the exhaust stroke. One of the author's critics pointed out very aptly that before water could be evaporated it must be present. This simple and obvious truth appears to have lain outside the author's horizon. Evaporation of dew from a cylinder wall must be very rapid when the pressure is relieved by the exhaust opening, and it must of necessity chill the cylinder surface. Since the molecules of steam have a velocity of nearly, or fully, 2,000 ft. per second, the cooled surfaces must be very quickly heated to steam temperature when the inlet valve opens. Even when a fourth of the steam which enters is thus condensed, this does not imply an unreasonable temperature range in the very thin inner skin. We fail entirely to see how the mean temperature at the middle thickness of the cylinder can show anything at all of the range of temperature in this thin skin. Should the mean cylinder temperature be, say, 250° F., may not this be caused by a skin temperature ranging from 240° to 260°? And may it not equally be the result of a range between 200° and 300°?

While apparently denying transfer of heat to the cylinder, the author appears to claim that the cylinder is hotter than the steam, an effect, if true, that simply proves that there must have been condensation—or whence the heat?

But if all the supposed cylinder effects are only leakage effects, how is it that we do not hear of piston leakages? Why should steam creep furtively past the valve, and be unable to make its way past the piston?

It is probable that the mean temperature of the cylinder metal has very little influence on the initial condensation, though as between jackets and no jackets there must be, in the former case, always an inward flow

of heat, and in the latter case certainly a mean outflow of heat. The author must be singularly immersed in his theory so to read or misread the figures of reduced evaporation when the jackets are in use. With highly superheated steam, and cylinder walls almost unworkably hot, there is no re-evaporation at all; the steam which finishes dry will be still further heated during exhaust, though owing to the diathermanous nature of dry steam gas there is not much absorption of heat by it. Under ordinary conditions not only do the cylinder walls lose heat to the water and steam in contact with them, but the water in suspension in the steam will absorb heat radiated from the walls and will increase the heat losses of the surfaces. To enter the field with a new theory and support it by mere assertions seems almost to admit defeat. And yet past experiments are put forward in this paper as though they were admittedly proved facts. Much more convincing arguments will be called for before engineers will believe that cylinder wall temperature in presence of wet steam will have so narrow a range as the author of this paper asks us to believe is the case.

CONTRACTS OPEN.

(*Continued from page* 17.)

Roumania.—January 14th. Tenders are being invited by the municipal authorities of Pitesti, for the concession for the electric lighting of the town.

The municipal authorities of Craiova have just invited tenders for the construction of a system of metre-gauge electric tramways in the town, and for the construction and equipment of the generating station required in connection with the same.

Siam.—BANGKOK. March 15th. Tenders are invited for the supply and erection of an electric power station with a capacity of 3,000 KW. Tenders, on the prescribed forms, to the Ministry of Local Government, Bangkok. For further particulars see this column for November 24th.

Swansea.—January 6th. Water-tube boilers, superheaters and mechanical stokers, for the Corporation Electricity Department. See "Official Notices" December 15th.

Turkey.—Tenders will be received at the "Ministère des Travaux Publics," Constantinople, up to 2 p.m. on February 20th, for a concession for the supply of electric light and power to the town of Adalia, which has a population of some 30,000. For particulars see this column December 22nd.

CLOSED.

Belgium.—Seven concerns (five Belgian and two German) submitted tenders to the Belgian General Direction of Roads and Bridges in Brussels for the establishment and equipment of a sub-transformer station on the Ghent Canal at Terneuzen, the lowest being that of M. A. Sarrens, of Brussels.

Derby.—The T.C. has accepted the tender of Messrs. Taylor, Whiting & Taylor for the electric light installation at the new schools in Reginald Street, at £188.

Dewsbury.—The Corporation has accepted the tender of the Union Cable Co. to supply 1¼ miles of cable, at £182.

Germany.—The Allgemeine Electricitäts Gesellschaft, of Berlin, has secured a contract from the Schlesische Electricitäts und Gas Gesellschaft, of Gleiwitz, for a 16,000-KW. steam turbine and alternator.

Halifax.—The tender of the Brush Electrical Engineering Co., Ltd., for the supply and fixing of 20 top covers to ors, at £92 each, has been conditionally accepted.

Haslingden.—The Corporation has placed the order for ectric lighting of the municipal offices and Council chamber with M:. A. M. Cramp, at £104. The same contractor carried out the lighting of the free library and public hall.

Irlam.—The announcement was made some little time ago that the British Westinghouse Electric and Manufacturing Co., Ltd., had secured the order from the Partington Steel and Iron Co., Ltd., of Irlam, for four large turbine blowers for blast-furnace work, and also turbo-generating machinery. We now learn that they have also secured the contract for the supply of all motors, with their control gear, &c., for the equipment of the new large works in question

Salford.—The T.C. has accepted the tender of Messrs. Willans & Robinson, Ltd., at £10,780, for the supply and erection of two 1,000-KW. Willans-Siemens turbo-generators.

South Africa.—The South African Union Government has just placed an order with the International Time Recording Co., of London, for 68 international Rochester card time recorders. We are informed that this is the largest single order for time recorders ever placed in Great Britain, and it was keenly competed for.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of Messrs. Tinker, Shenton & Co., Ltd., for the supply of three boilers.

Wrexham.—The following tenders were received by the Electricity Department for main switchboard:—

Whipp & Bourne	£736
Bertram Thomas (accepted)	762
Siemens Bros. Dynamo Works, Ltd.	773
Electric and Ordnance Accessories Co., Ltd.	788
Spagnoletti, Ltd.	1,003
A. Reyrolle & Co., Ltd.	1,058
Crompton & Co., Ltd.	1,137
General Electric Co., Ltd.	1,197
Walsall Manufacturing Co., Ltd.	1,805
Ferranti, Ltd.	1,385
Electric Construction Co., Ltd.	1,438
Johnson & Phillips, Ltd.	1,465
British Westinghouse Manufacturing Co., Ltd.	1,525
Electrical Engineering and Agency Co.	1,744

No tender has been accepted for the motor-generator panel.

York.—The Tramways Committee of the T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for four tramcars, at £550 10s. each.

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, January 6th. At St. Bride's Institute, E.C. Social. Dance.

Wednesday, January 10th.—At 8 p.m. At St. Bride's Institute, E.C. Paper on "Notes on Hand-Firing *versus* Mechanical Stoking," by Mr. F. F Evans.

Institution of Mechanical Engineers (Graduates' Association).—Monday, January 8th. At 8 p.m. Paper on "Oil Engines," by Mr. G. R. Dalkin.

Institution of Electrical Engineers (Newcastle Students' Section).—Monday, January 8th. At 7.30 p.m. At the Armstrong College, Newcastle. Discussion on "The Localisation of Faults in High and Low-Tension Cables," to be opened by Mr. B. A. M. Cooper.

Institution of Electrical Engineers (Scottish Local Section).—Tuesday, January 9th. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Illumination," by Mr. J. D. MacKenzie.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, January 10th. At 7.30 p.m. At the University, Birmingham. Paper on "Dynamos for Motor Road Vehicle Lighting," by Mr. J. D. Morgan.

Institution of Electrical Engineers (Yorkshire Local Section).—Wednesday, January 10th. At 7.15 p.m. At the University, Sheffield. Paper on "Some General Principles Involved in the Electrical Driving of Rolling Mills," by Mr. C. A. Ablett.

Association of Mining Electrical Engineers (London Branch).—Thursday, January 11th. At 8 p.m. At the Junior Institution of Engineers. Paper on "Electricity in Connection with Explosives" to be discussed.

Institution of Electrical Engineers (Dublin Local Section).—Thursday, January 11th. At 8 p.m. At the New Royal College of Science, Dublin. Paper on "Peat as Gas-Engine Fuel: New Developments," by Mr. T. Tomlinson.

Institution of Electrical Engineers (London).—Thursday, January 11th. At 8 p.m. Paper on "Some General Principles Involved in the Electrical Driving of Rolling Mills," by Mr. C. A. Ablett.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders are issued:—

Monday, January 8th.—"A" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Tuesday, January 9th.—"B" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Thursday, January 11th.—"C" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Friday, January 12th.—"D" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Saturday, January 13th.—Headquarters will be opened for regimental business from 10 a.m. to 12 noon.

(Signed) J. H. S. PHILLIPS, Major,
For Officer commanding L.E.E.

Annual Festivities.—The annual staff frivolities of the ST. HELENS CABLE AND RUBBER CO., LTD., took place on December 23rd, in Warrington. The dinner was held at mid-day in the works dining hall, and dealt mainly with turkey and plum pudding. Afterwards, advantage was taken of the presence of lady members of the staff to institute parlour games, in which forfeits involved the time-honoured use of mistletoe. The whist drive, supper, and dance, at the Winmarleigh Rooms, was attended by about 100, and went with a swing.

NOTES.

A Shut-Down—From the Legal Point of View.—Our legal contributor writes as follows regarding the article entitled, "Nearly a Shut-Down," which appeared in the REVIEW of December 29th :—

"The article suggests an interesting question from the lawyer's standpoint. A perusal of that article, though it bids fair to confuse a mind which scarcely appreciates the difference between the lighting peak and a rheostat, makes it plain that it is only by providing for the unexpected that the breakdown can be avoided. But what is the liability of an electricity supply authority in this regard? Suppose the town or district is plunged in darkness owing to a breakdown, what are the consequences? An accurate appreciation of their legal liabilities appears to be important, inasmuch as enormous sums are obviously spent in duplicating sets, and in making provision to deal with emergencies. Lulled into a sense of security, it is possible that those who are responsible to shareholders as well as consumers, might be tempted to effect a saving by omitting to renew or keep their stand-by plant in repair.

"If reference be made to the Acts which deal with the supply of electricity for lighting purposes, it will be found that the possibility of accident has been specially provided for. The Electric Lighting Clauses Act, 1899, provides that whenever the undertakers make default in supplying energy in accordance with the terms of the Board of Trade Regulations, they shall be liable to such penalties as are prescribed in the Regulations in that behalf. These penalties may be recovered summarily. The effect of the clause which provides for them is to impose a duty on every electric lighting company to keep up a constant supply. But they are not to be held liable in every case of stoppage. Thus there is a proviso to the effect that the penalties to be inflicted on the undertakers must in no case exceed in the aggregate the sum of £50 in respect of any defaults not being wilful defaults on the part of the undertakers for any one day, and provided also, that in no case shall any penalty be inflicted in respect of any default, if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply.

"What, then, is inevitable accident? There are few cases on the subject; but it may be presumed that a stoppage due to the negligence of one of the servants of the lighting authority would not come under this head. In the case of Sun Insurance Co. *v.* Dublin Corporation (December 9th, 1899) a cable which had been laid down proved to be defective; and the supply of electricity accordingly broke down. This failure was held to have been caused by inevitable accident. This case, however, does not completely establish the proposition that a burning out is an inevitable accident. It is presumed that the Court would make inquiry into the cause of the burn-out. Thus, if a company, with a view to saving the expense of a new cable were to deliberately overload an old one, an accident arising from this cause could scarcely be looked upon as inevitable. Again, suppose that a large addition was made to the list of consumers so that the machinery at the generating station might occasionally be taxed to its utmost capacity, a breakdown resulting from such a cause could hardly be regarded as inevitable.

"With regard to *force majeure*, this is a legal phrase which relates to the happening of something for which the company could not reasonably be held liable, *e.g.*, a flood, an earthquake, or a subsidence sufficiently violent to sever the cables.

"As to a breakdown due to an increase in the number of consumers, there is only one case and this throws a somewhat doubtful light on the subject. I refer to Marylebone Vestry *v.* Metropolitan Electric Supply Co., which was heard in January, 1900. The company were summoned for making default in supplying energy to the workhouse and Vestry offices on certain days. They admitted the default, but pleaded, in extenuation, that their inability was due to inevitable accident caused by a great demand for electricity, which had exceeded all expectations. The case was adjourned for three months, and was not heard of again.

"In Shaddick *v.* London Electric Supply Corporation (May 8th, 1900), the keeper of a licensed house at Deptford summoned the London Electric Supply Corporation for failure to supply his premises. The default was admitted, but the defence was *force majeure*, it being contended that, the supply of electricity having become deficient owing to unavoidable causes, it became essential that some part of the district of the company should be cut off, and that Deptford was selected as causing the least public inconvenience. The full penalty of 40s. was inflicted in each of the seven cases, with 20 guineas costs in the first case and 2s. costs in each of the others."

Prize Competition.—The Société Industrielle de Mulhouse is offering prizes for :—(*a*) A new process or application of electricity to the bleaching, dyeing, and printing of textiles; (*b*) the electrical driving of a machine of very variable speeds by a three-phase motor. The results and power factors must equal or exceed those of the motors previously premiated by the Society, but great importance is attached to the simplicity of the motor and accessory apparatus and to continuous working; (*c*) a comparative study of the electrical and mechanical working of a textile factory, showing their respective advantages and disadvantages, based on the results of actual experience; (*d*) a study of the use of electricity in textile operations carried out in the worker's home, whether it induces an increased output, its social consequences, and its effect on the work of the factory.—*La Revue Electrique.*

Parliamentary.—BRIGHTON TRAMWAY PROJECTS.—No fewer than four Bills have been deposited in the Private Bill Office for extending the tramway facilities at Brighton, chiefly in the form of the construction of railless traction systems. The Brighton Corporation has put in the following estimates: For purchase of lands, sheds and buildings, &c., £35,170; for overhead equipment, shelters and miscellaneous equipment, £23,230; for trolley vehicles, £46,000; and for the running of omnibuses, £30,000. The Bill provides not only for running in Brighton, but also in the borough of Hove and the urban districts of Portslade, Southwick and Shoreham, and power is taken for agreements with neighbouring authorities as to leasing, running powers, &c. The Hove Corporation Bill is on very similar lines to that of the Brighton Corporation in respect to the districts to be worked, but Clause 36 gives authority for the appointment of a joint Committee for working the system. The estimates also are very similar, viz.: Land for generating station, &c., £4,000; erection of generating station and other necessary buildings, £20,000; overhead equipment, &c., £29,000; provision of trolley vehicles, £24,000; and motor-buses, £24,000. The third Bill is that of the Brighton, Hove and Preston United Omnibus Co., Ltd., whose proposals are rather wider, as they propose constructing a railless route to Worthing. They also seek power to purchase the Hove, Worthing and District Tramways undertaking of the British Electric Traction Co. Lastly, the Brighton District Tramways Bill incorporates a company with a capital of £75,000 to take over the Hove and Worthing tramways of the British Electric Traction Co., and George Balfour and Andrew Henry Beattie are named as the first two directors.

RAILWAY ELECTRIFICATION IN LONDON.—The text of the Bill for next session deposited by the London and North-Western Railway Co. gives full details of the proposed electrifications of the North London Railway and railways in the south-western portions of London. The company take power to lay down electric mains on (1) the North London Railway; (2) the North and South-Western Junction Railway; (3) so much of the London and South-Western Railway as lies between (*a*) the North and South-Western Junction Railway at South Acton Junction and Gunnersbury Station; and (*b*) the North and South-Western Junction Railway at Kew East Junction and New Kew Junction, together with the siding situated on the north side of the London and South-Western Railway between the said New Kew Junction and Chiswick Junction. By Clause 35 the London and North-Western, the Midland, the London and South-Western and the Metropolitan District, or any two or more of them, may enter into agreements with respect to the adoption of their railways, or any portion of them, for electrical working, and with respect to the supply of electrical current. Clause 37 gives the company power to supply electricity to manufactories on the route of the railway, but not unless the consent of the authorised supplier of the district is given.

ELECTRIFICATION OF THE EAST LONDON RAILWAY.—Full powers are being asked for by the Great Eastern Railway Co. in their Bill to be brought before Parliament next session for the electrification of the East London Railway, and by Clause 39 the Joint Committee is authorised to enter into agreement with the Metropolitan District Co. and the London Electric Railway Co., or any other company or authority or person authorised to supply electrical energy, for a supply of the necessary energy. The Great Eastern Co. is further empowered to issue £90,000 4 per cent. debenture stock for such electrification.

KINGSTON-ON-HULL CORPORATION TRAMWAYS.—The Bill of the Kingston-on-Hull Corporation, which has been deposited in the Private Bill Office, contains the following estimates of the cost of works proposed to be undertaken :—Construction of tramways, £28,000; generating station and equipment, £55,000; additional lands and buildings for tramway purposes, £12,000.

New Insulators.—H.M. Consul at Philadelphia, U.S.A. (Mr. W. Powell), has furnished a report on a new material, manufactured by a secret process, and stated to be a substitute for hard rubber, cork, horn, &c. The manufacture is claimed to be simple and cheap. The material is made mostly of anything that contains vegetable fibre. It is claimed that it can be turned out, with a profit, at 4½d. per lb. Exhaustive tests made in the United States show, it is stated, that electrically it is equal, if not superior, to hard rubber, fibre, porcelain, cork, horn, &c., and would take the place of these materials in several of their uses. Its power of resisting heat is said to be almost if not quite equal to that of asbestos, and it is extremely tough and very difficult to break. In its first stages of manufacture, being perfectly plastic, it can be moulded into any shape desired. The report, together with particulars of the results of tests of the material made in the United States of America, may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade.

It is reported that a London chemist has succeeded in producing from seaweed an entirely new composition having high insulating properties, and capable of being used instead of vulcanite or leather; it is waterproof and fire-proof, and is unaffected by acids and oils. It is suggested that it is well adapted for the insulation of deep-sea cables. A company is being formed for its manufacture on a large scale, under the name of "Seagumite."

A Report on Olympia Exhibition.—A deputation sent by the Electricity Committee of the Bradford Corporation to visit the Electrical Exhibition at Olympia recently issued their report, in which they state that the principal feature of the Exhibition was the display of electric heating and cooking apparatus and of drawn-wire filament lamps, and that, on the whole they were rather disappointed.

Staff Dinner.—At the Hotel Richelieu, Oxford Street, W., on Saturday last, the first staff dinner of Messrs. Krupka and Jacoby, of Queen Victoria Street, E.C., was held. From the principals down to the juniors the whole staff was present, whilst the visitors were represented by Mrs. Jacoby, Miss Loeffler, Mrs. W. E. Pott, Mrs. L. Hermes and Mrs. F. W. Fifield. The chair was occupied by Mr. Jacoby, who was supported by Mr. Krupka, Mr. W. E. Pott (manager), Mr. J. Stevenson (secretary), together with Messrs. F. Burland, L. Hermes, F. W. Fifield, L. Evans, G. H. Band, and E. F. Maas, the firm's representatives for the British Isles. The arrangements were left in the capable hands of Miss Dawson, and an excellent banquet was presented and thoroughly enjoyed.

After the loyal toast had been drunk, "The Firm" was toasted by Mr. W. E. Pott in a spirited speech, in which he dwelt on the whole-hearted and genial disposition of both partners, their accessibility to the staff, and the interest they took in the welfare of all their employés. This toast was heartily endorsed, and was responded to by Mr. Krupka. Mr. J. Stevenson proposed the toast of "The Staff," and paid a special compliment to the manager, Mr. Pott. His remarks were seconded by Mr. Hermes. Mr. F. W. Fifield, in felicitous mood, proposed the toast of the evening, "The Visitors," and Mrs. Jacoby returned thanks on behalf of the ladies.

Immediately after the toasts the principals handed, through Mrs. Jacoby, a useful gift to everyone present in commemoration of the occasion. During the evening very many references were made regarding the "Graetzin" metal-filament lamp, for which Messrs. Krupka & Jacoby are the sole agents for the British Isles, and its progress. Other gentlemen to say a few words during the evening were Mr. Burland, the firm's oldest representative, and Mr. Moody, the storekeeper, who had been with the firm since they started.

The musical and humorous programme of the evening included some improvised verses by Mr. Maas, on the Graetzin lamp. "Auld Lang Syne," with New Year wishes, and the singing of "God Save the King," brought the proceedings to a close.

Observatories and Lightning.—M. J. Vallat, in the *Comptes Rendues de l'Acad. des Sciences*, gives the results of his investigations on the protection of observatories situated at a great height from lightning. From observations made at two of the observatories on Mont Blanc, the author concludes that if the earth line connecting the lightning conductor with the rock is long, the observatory cannot be effectually protected. On the other hand, the Observatory des Boues is extremely well protected (it has never been struck) in the following manner:—Four conductors with multiple points are fixed on the roof and connected together by wires. From each conductor a 5-mm. iron wire descends to the rocks and ends in a spiral among the gravel. The whole observatory is also clad with thin copper sheets, in metallic contact with the conductor, the iron wires and the ground. The electric discharge thus finds a large, highly conductive surface to spread itself over, the points of contact being made as numerous as possible. The stove pipe is also in contact with the copper envelope. Thus equipped, the observatory forms a complete Faraday cage.—*La Revue Electrique.*

Legal.—Verney *v.* Glenville & Osmond.—An important point was raised in cases at Bacup Petty Sessions on Wednesday, last week, brought by H.M. Inspector of Factories against Glenville and Osmond, cinematograph owners, of the Bacup Public Hall, in which the defendant firm were summoned for breaches of the Factory Act on October 26th.

Mr. Brother, of Manchester, H.M. Inspector of Factories, who appeared on behalf of Mr. Verney, said that when the latter visited the defendants' premises, Burnley Road, Bacup, he found generating plant for electricity for the lighting of the Public Hall, and he found there was no abstract of the Factory Acts affixed at the premises in which electricity was generated. Ten years ago electricity generating stations were included in the term "factory" by the 1901 Act. The defendants were also summoned for not having the fly-wheel of the gas engine, 8 ft. in diameter, and other dangerous machinery fenced.

Mr. Evans, solicitor, Haslingden, for the defence, contended that the electrical stations contemplated by the Act were those where electricity was generated in considerable bulk for public supply or for trading or manufacturing purposes, and not for a place of that sort, where it was only for an entertainment. A cinematograph hall was not a public place, and the public had no right there. It has been held that a workhouse was a public building, but that was different from either a theatre or a cinematograph show. Mr. Brother had not given them a single case where a cinematograph show had been held to be a factory. In the case of a workhouse, where there was considerable electricity generated and there was considerable plant, it was quite different. The cinematograph exhibition was not an industrial undertaking, and he thought the Bench ought not to say it was a factory.

He called Mr. Clay, defendants' manager, who said he had been connected with such concerns for 18 years, and had never seen an Abstract of the Factory Act exhibited in any of them.

Mr. Brother said they were not concerned, for the purposes of the Act, with either the kind or extent of the trade that was carried on in the building, but only with the fact that electricity was generated there for light for the Public Hall. If their Worships wished to have a case decided on all fours in the High Court, they could do so, if they would go to the cost, but he could assure them that such places were factories, and they had only to deal with the part of the premises where the electricity was generated. There had been cases decided on the point with regard to merry-go-rounds. The extent of the business had nothing to do with it.

The Bench found that it was a factory within the meaning of the Act, and imposed a penalty of 1s. and costs for not fencing the machinery, and costs for failing to affix the Abstract.

Inquiries.—The makers of an electrical vulcaniser for motor-car tires are inquired for; also makers of Shaw's patent Liverpool lightning arresters.

Faraday House Old Students' Association.—The annual smoking concert of this Association will be held at the Holborn Restaurant, Council Room, on Friday, January 19th, at 8.30 p.m. sharp. Mr. H. H. Perry, M.I.E.E., president, will be in the chair. Tickets and all particulars may be obtained from the Honorary Secretary, Faraday House, Southampton Row, London, W.C.

Fancy Dress Ball.—The annual fancy dress ball of the Robertson & Osram Social and Athletic Club will take place at Brook Green Works, Hammersmith, on Saturday, January 13th, at 7 p.m.

Reduction in German Wire Lamp Prices.—A general reduction in the prices of metallic-filament lamps has taken place in Germany. The initiative was taken by the Deutsche Gasglühlicht (Auer) Gesellschaft, who were quickly followed by the A.E.G. and by Messrs. Siemens & Halske. The last firm, in the course of a further communication, explains the attitude of the principal makers. The company remarks that both the tantalum and the tungsten lamp were made with drawn-wire filaments from the beginning. As a result of obtaining licences, the construction of tantalum lamps was undertaken by American factories on a large scale some years ago. The favourable experience gained with this lamp, and the circumstance that the Siemens & Halske Co. succeeded in drawing wire for the tungsten lamp three years ago, caused further experiments to be made in this direction. Eventually the Americans were successful in devising improved methods for the manufacture of drawn tungsten wire, although they were dependent upon the German company's patented process for winding the wire in a single length on a frame. An understanding was thereupon arrived at between the Siemens & Halske Co. and the American company with regard to the mutual exchange of patents concerning tungsten lamps. The arrangement, as a result of existing agreements, was simultaneously extended to the A.E.G. and the Deutsche Gasglühlicht (Auer) Gesellschaft, so that both these companies are authorised to manufacture according to the patents in question. Presumably all makers who are debarred from using the patents for mounting the filaments will find it extremely difficult to compete with the other makers of drawn-wire lamps under the altered circumstances.

Educational.—University College.—The work of the Second Term begins on Tuesday, January 9th. Among the Special and Advanced Courses which have been arranged in the Faculty of Engineering are "Illumination and Photometry," by Mr. W. C. Clinton, on Wednesdays, at 6.30 p.m., beginning January 10th; and "Water Supply, Sewerage and Lighting," by Mr. R. E. Middleton, on Thursdays, at 9 a.m. and 4 p.m., beginning January 11th, at 4 p.m. Particulars may be obtained from the Secretary of the College.

Institution and Lecture Notes.—National Electric Light Association, U.S.A.—The Association, which in July, 1909, had a membership below 3,000, now numbers over 10,000 members.

Institution of Mining Engineers.—At a meeting in Newcastle, two mining managers, who had been charged with the duty of testing the Ralph gas-testing lamp, reported that, while the lamp acted admirably with coal gas, it completely failed to indicate the presence of fire-damp in a pit. This result was totally unexpected, as no one had foreseen a difference in the behaviour of the gases. Prof. Bedson stated that, in the case of the combustion of marsh gas, there were three stages, in none of which was sufficient heat developed to produce the reaction which enabled the platinum to indicate the presence of coal gas. He thought the discovery would enable the inventor to proceed on lines which would lead to the desired end.

American Institute of Electrical Engineers.—At the December meeting of the board of directors a new policy was adopted, the proceedings of the governing body being made public. According to the report in the *Electrical World*, a resolution was passed expressing the desirability of the more general use of the metric system, and directing that in all publications of the Institute measures expressed otherwise than in the metric system should be accompanied by the metric equivalents in parentheses. This practice is already followed by some of the leading American engineering societies. It was decided also to open communications with foreign electrical engineering societies with reference to the mutual establishment of visiting-member privileges, so that members of the Institute when visiting a foreign country might, upon the presentation of credentials, have the privilege of temporary membership of the society in that country, and *vice versa*.

There are only two grades of membership in the Institute, 10 per cent. being Members, and 90 per cent. Associates, and this anomaly has led to a proposal to reorganise the membership in three grades, the names suggested being "Fellow," "Member," and "Associate." It appears that these classes will correspond roughly with the classes of Member, Associate Member, and Associate of the British Institution. The proposal was provisionally adopted.

On January 17th a party of members of the Institute will leave New York for a trip to the Isthmus of Panama, joining a party from New Orleans at Colon on January 25th. After visiting the Canal works, the party will return on February 8th.

SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The annual dinner took place on December 8th, Mr. J. H. Rider, president, being in the chair. Mr. Rider, in responding to the toast of the Institute, said that until quite recently, the electrical engineers on the mines suffered under the disability of not being officially recognised by Government. The Government had now introduced new regulations, and recognised the electrical engineer, and had authorised him to become certificated, and, indeed, as far as the regulations were concerned, had put him on a level with the mechanical engineer. He hoped that the mechanical and electrical engineers would all work together for one common end—the benefit of their employers. The future of the Institute, he said, was well assured.

Federal State Monopolies in Germany.—A Bill was recently introduced in the Diet of the Grand Duchy of Gotha to authorise an agreement which has been arranged between the Government and the A.E.G. with regard to the establishment of an overland central station and the construction of light electric railways in the Grand Duchy. The agreement provides that the company shall erect a station capable of supplying all parts of the Duchy, and that the undertaking shall be independent of the company's other enterprises, and have headquarters in Gotha. The company is to be authorised to use and cross over all roads for the installation of overhead or underground cables for the transmission of energy, while, on the other hand, a payment is to be made to the State amounting to from ½ per cent. to 1 per cent. of the gross receipts. During the first four years of the agreement the company has to make provision for supply to 34 communes in addition to the seven towns in the Duchy, and similar arrangements in relation to the remaining communes have to be made in the succeeding period of four years. The first light railway to come into consideration will be between Gotha and Friedrichroda, which will have branches to Waltershausen and Grosstabarz. At the request of the Ministry, the company will construct other lines specified in the agreement, which will serve localities which have not been provided with railway connections owing to the conservative policy of the Prussian Railway authorities, who apprehended that the lines would prove unprofitable. It is expected that the agreement, which is for a term of 50 years, will be sanctioned by the Diet without any opposition, as it will meet requirements which have been recognised for a long time past. The way towards an electrical monopoly is also being paved in the Grand Duchy of Hessen, where the Rhenish Schuckert Co. is constructing an overland central station for Rhenish-Hessen. In addition, the Ministry is in negotiation with the company with regard to the lease of the State works to be erected near Wolfersheim, and the company is said to be also associated with other schemes in the Duchy.

Temperature Coefficient and Resistivity.—As the result of experiments at the Reichsanstalt, Mr. St. Lindeck finds that the average density of 63 samples of copper is 8 89, and that there is a constant relation between the resistivity and the temperature coefficient of copper, such that the product of these values, at 15° C., is $6{\cdot}8 \times 10^{-5}$, with a variation rarely exceeding 1·5 per cent. From this datum it is possible to determine the resistivity of copper in a form which prevents the direct measurement—for example, a wound bobbin—as the temperature coefficient can easily be ascertained, though the dimensions of the conductor cannot. According to the measurements of Dellinger, the resistance of copper between 10° and 100° C. varies with temperature according to a linear relation; the product of resistivity and temperature coefficient is, therefore, practically constant for different values of the temperature, and need only be measured at one temperature. Thus, to find the resistivity of copper of any quality at a temperature t_2, when it is known at a temperature t_1, it is only necessary to determine the value of $(t_1 - t_2)\ 6{\cdot}8 \times 10^{-5}$ and to deduct it from the latter. Similar results have been found for aluminium and iron. Mr. Lindeck points out that Mathiessen and Vogt found the constancy of this product in the course of their experiments, in another form, but that it passed completely unnoticed.

Big Boilers.—The Delray station of the Detroit Edison Co., says the *Electrical World*, contains turbines aggregating 75,000 KW., including four 14,000-KW. sets. These are fully loaded only during the peak hours, and show the highest efficiency in the neighbourhood of 8,000 KW. The large boilers used in conjunction with them have a similar efficiency curve; they are of the double-fired Stirling type, and each has a normal output of 7,000 KW., but they have been run up to 11,000 KW. for short periods. Five have been erected—in addition to smaller boilers—and five more are about to be installed. The dimensions of one of them are 31 ft. wide × 36 ft. high × 28 ft. deep; heating surface, 23,654 sq. ft. There are 1,564 3½-in. tubes, one 54-in. and two 48-in. steam drums, and two 48-in. mud drums. The boilers are fired from both ends, three with Roney stokers and two with Taylor underfeed stokers. The grate area of the former is 453 sq. ft., and of the latter 300 sq. ft. The boilers work at 205 lb. pressure, and are provided with superheaters giving a superheat of 150° F. Forced draught is used. The boilers were constructed by the Babcock & Wilcox Co. The combined efficiency of boiler and furnace (of either type) is said to be 80 per cent. at the nominal rated load, falling to 76 per cent. at double rating.

Postal Engineers.—The Postmaster-General has announced that the Treasury has sanctioned a revision of the engineering department of the Post Office. According to the *Daily News*, the future classification and rates of pay, minimum and maximum, are to be as follows in the superintending branch:—

	Salary.	London allowance.
Superintending and staff engineers	£520 to £700	£50
Assistant do.	420 to 500	40
Executive engineers	315 to 405	30
Assistant do.	150 to 300	20
Chief inspectors	150 to 200	20

Where the rates of pay are fixed by the week the scales are as follows:—

	London.	Provinces.
Senior inspectors	57s. to 65s.	52s. to 60s.
Inspectors	30s. to 55s.	30s. to 48s.
Skilled workers (I)...	39s. to 47s.	37s. to 45s.
„ „ (II)...	26s. to 38s.	24s. to 36s.

Skilled men not on the establishment are to be paid at the rate of 6½d. to 7¾d. per hour in London and 5d. to 7d. per hour in the provinces. The pay of boys and youths in London ranges from 2½d. to 4½d. per hour, and in the provinces from 2d. to 3¾d.

The present distinction between the maintenance and construction staff is not to be maintained, and the whole of the adult force below the rank of inspector will be divided between skilled and unskilled classes. Fifty per cent. of the skilled workmen will be brought on the establishment, with the result that about 1,100 newly established posts will be created to be filled from the unestablished maintenance and construction ranks.

From January 1st the Post Office factories have ceased to exist as a separate department, and have become part and parcel of the stores department. The post of Controller of Post Office Factories is also abolished.

Magnification of Electric Currents.—At a meeting of the National Academy of Sciences held in New York, Prof. M. I. Pupin gave a preliminary account of a theoretical and experimental investigation of the problem of magnifying the feeble electric currents used in cable telegraphy and telephony. As a result of experimental work conducted during the past five years, Prof. Pupin has developed and built an induction-type generator, by means of which feeble currents in a circuit can be magnified to any desired extent, the generator acting locally somewhat as an energy relay. The feeble current is passed through the primary circuit of the generator, the secondary of which consists of a small disk of copper driven by external power. On account of the self-excitation of the machine and the reaction between the primary and secondary currents, the current in the primary is enormously augmented. In the early experiments, considerable difficulty was encountered by reason of an inherent tendency of the machine to become excited automatically to an excessive degree. In a machine recently completed, these difficulties have been overcome, and the theory of its operation, which was worked out by Prof. Pupin some years ago, has been thoroughly verified. Prof. Pupin has announced his intention of describing both the theory and the machine in detail in a paper to be presented before the American Institute of Electrical Engineers.—*Electrical World.*

Appointments Vacant.—Assistant junior demonstrator in the electrical engineering and applied physics department of the Northampton Polytechnic Institute; dynamo and switchboard attendant, for the Bethnal Green B.G. (32s.); mains superintendent, for the Municipality of Port Elizabeth, South Africa (£250). See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. L. G. HARRIS, assistant resident engineer, Chester Street generating station of the Birmingham Corporation, who is resigning his present position for an appointment with Messrs. Vickers, Son & Maxim, Manchester, was on December 29th presented with a travelling bag as a token of esteem by the staff and employés.

MR. G. DEARLE, assistant mains superintendent at Derby, has resigned, and the T.C. has appointed Mr. T. BING and Mr. H. C. MITCHELL as district inspectors of mains.

MR. FRED TYRRELL, charge engineer to the Leatherhead and District Electric Co., Ltd., has been appointed assistant electrical engineer to the Ascot Gas and Electricity Co.

MR. RAYNER, engineer-in-charge at the York Corporation electricity works, has resigned.

MR. J. G. THAW has been appointed chief assistant engineer to the Stratford-on-Avon Electric Light and Power Co., Ltd. Mr. Thaw was previously engaged at Gloucester for seven years as charge engineer.

MR. H. L. COTTAM, shift engineer at Dewsbury Corporation electricity works, has obtained an appointment Colchester

MR. R. H. CAMPION, borough electrical engineer at Dewsbury, has resumed his official duties after having been seriously ill for several months.

The Tramways Committee of Salford T.C. has appointed MR. H. WESTON to be overhead equipment superintendent. The Electricity Committee has promoted MR. F. BARLOW to the position of superintendent of the electrical testing and high-motor department.

General.—NEW YEAR HONOURS.—The list of honours announced this week includes the following. To all of these gentlemen the ELECTRICAL REVIEW tenders its congratulations:—

SIR FRANCIS J. S. HOPWOOD, formerly Permanent Under-Secretary of the Board of Trade, is to be sworn a Privy Councillor.

MR. R. COLLINGWOOD FORSTER, who recently gave £30,000 for the new Chemical laboratories at University College, is made a baronet.

MR. THOMAS SKINNER, founder of the *Stock Exchange Year Book*, and chairman of the Halifax and Bermudas Cable Co., Ltd., and a director of the Commercial Cable Co., also receives a baronetcy.

PROF. W. F. BARRETT, F.R.S., M.I.E.E., who has just retired from his position as Professor of Experimental Physics at the Royal College of Science, Dublin, receives the honour of knighthood.

MR. JOSEPH BEECHAM, a director of the Lancashire United and other electric tramway companies, is made a knight.

MR. J. MACKENZIE DAVIDSON, M.B., C.M., whose researches in X-ray work are so well known, and who is consulting surgeon to the X-ray departments at the Charing Cross and Royal London Ophthalmic Hospitals, also receives the honour of knighthood.

MR. A. B. KEMPE, D.Sc., F.R.S., treasurer of the Royal Society, and a distinguished mathematician, is made a knight.

PROF. H. A. MIERS, D.Sc., F.R.S., Principal of the London University, is knighted.

Among those receiving the "C.B." are MR. W. F. MARWOOD, assistant secretary of the Board of Trade in the Railway Department, and MR. A. M. J. OGILVIE, one of the assistant secretaries of the G.P.O.

MR. W. B. COWNIE, formerly general manager and secretary of the National Electric Construction Co., Ltd., has been appointed managing director of the company, the old title, therefore, falling into disuse. Mr. Robert Watson, formerly accountant, has been appointed secretary of the company.

Out of 49 applicants, MR. N. J. YOUNG, Bristol, has been appointed general manager of the Newport, Mon., electricity and tramways undertaking at a salary of £400. Mr. Young, who commences his duties on March 1st, is 34 years of age, and has had 13 years' experience with the Bristol Tramways and Carriage Co., Ltd. He was clerk to the tramways traffic manager at that town for five years, and is at present assistant to the managing director and secretary.

MR. SCAIFE, of Stockport, has been appointed chief electrician at Stanlow Works, Ellesmere Port.

MR. H. B. RENWICK, formerly general manager and secretary of the County of London Electric Supply Co., Ltd., has been elected to a seat on the board and appointed managing director. MR. F. C. MCQUOWN, formerly assistant secretary, has been appointed secretary to the company.

MR. A. W. BLAKE, consulting engineer, announces that his address has just been changed to "Sketty," Swansea, where he will continue to devote himself more especially to the electrical and mechanical equipment of works and collieries, and to electric lighting schemes for public purposes.

MR. G. E. WRIGHT, M.I.E.E., electrical engineer to the North-Western Railway, Lahore, India, will be in England on furlough in March.

The *Australian Mining Standard* states that a sum of £750 has been put in the Commonwealth Estimates for the purpose of enabling one or more officers of the Postmaster-General's Department to go abroad and study the latest developments in similar departments in other countries, and there is a probability that, as regards telegraphic and telephonic improvements, the choice will fall on MR. JOHN HESKETH, the departmental electrical engineer.

MR. E. C. BEMAN, who has filled various important positions with the Edison & Swan Co. (head office), both in an indoor capacity and as outdoor representative, his total period of service extending over more than 12 years, has just severed his connection with the company in order to take up an appointment with the Brush Electrical Co., Kingsway (Supplies Department).

Tramway Officials.—The Tramways Committee of the Newcastle Corporation on Thursday last week decided to increase the salary of the manager, Mr. ERNEST HATTON, by £100, and he will receive £100 advance 12 months hence, making his salary £1,000 per annum.

Obituary.—MR. F. BENNETT.—The death occurred on December 26th, at Portsmouth, of Mr. Fredk. Bennett, chief inspector of the National Telephone Co., Ltd. He was 53 years of age.

MR. E. K. SANCTOR.—The death occurred, on December 26th, of Mr. E. K. Sanctor, director of Messrs. Fraser & Chalmers, Ltd., electrical and manufacturing engineers, of Erith and London. The deceased gentleman, who was 71 years of age, was for some years superintendent of the Erith works of the firm, and on his retirement about a year ago he was appointed local director. Prior to coming to Erith he was associated with the Dickson Manufacturing Co., of Scranton, Penn.

NEW COMPANIES REGISTERED.

Parana Corporation, Ltd. (119,233).—This company was registered on December 19th, with a capital of £50,000 in 48,000 preferred ordinary shares of £1 each and 40,000 deferred ordinary shares of 1s. each, to carry on the business of constructors, financiers and managers of railways, engineering and electrical works, tramways, docks, factories, buildings, &c., and to adopt an agreement with the Inter-Continental Contractors, Ltd. The subscribers (with one share each) are:—H. M. Morrison, Highfield, Leckhampstead, Newbury, Berks., electrical engineer; N. H. Boyns, 20A, John Street, Bedford Row, W.C. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Registered by Gush, Phillips & Co., 3, Finsbury Circus, E.C.

Constant Vacuum Carburettor Syndicate, Ltd. (119,250).—This company was registered on December 20th, with a capital of £3,000 in 10s. shares, to carry on the business of mechanical, electrical and general engineers, electricians, machinists, tube makers, manufacturers of electric apparatus, founders, &c., and to adopt an agreement between F. Edwin and E. J. Smallpage, for the acquisition of certain patents governing carburettors. The subscribers (with one share each) are:—F. Edwin, 11, Market Street, Paddington, engineer; L. A. B. Shipment, 256, Portsdown Road, Maida Vale, N.W., cashier. Private company. The number of directors is not to be less than two or more than seven; the subscribers are to appoint the first. A. W. Hoale is the first secretary. Registered office, Market Street, Paddington.

National Carbide (1911), Ltd. (119,203).—This company was registered on December 18th, with a capital of £10,000 in £1 shares, to carry on the industrial, experimental and commercial exploitation of any chemical or electrochemical processes, including particularly the manufacture and sale of carbide of calcium and products thereof and primary materials therefor, and to adopt an agreement with National Carbide Co., Ltd. The subscribers (with one share each) are:—E. K. George, The Brackens, Ascot, gentleman; S. C. K. George, 41, Courtfield Road, S.W., gentleman. Private company. The number of directors is not to be less than two or more than seven; the first are S. K. George and S. C. K. George. Registered office, 11, Queen Victoria Street, E.C.

W. H. Rayner & Sons, Ltd. (119,268).—This company was registered on December 20th, with a capital of £4,000 in £5 shares, to carry on the business of electrical and general engineers at 166, London Road, Nottingham. The subscribers (with one share each) are:—J. H. Rayner, Winthorn, Radcliffe Road, West Bridgford, engineer; G. Rayner, Brooklyn, Radcliffe Road, West Bridgford, engineer; W. H. Rayner, 48, Holme Road, West Bridgford, engineer. Private company. The number of directors is not be less than two or more than five; the first are J. H. Rayner, G. Rayner and W. H. Rayner (all permanent); qualification, £200. Registered by Charles Doubble, 14, Serjeant's Inn, E.C.

Brolt, Ltd. (119,248).—This company was registered on December 20th, with a capital of £15,000 in £1 shares, to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical machinery, plant, fittings and apparatus of all kinds, &c., and to adopt agreements with B. Brooks and W. Holt. The subscribers (with one share each) are:—B. Brooks, Blackwell Court, near Bromsgrove, director; A. C. Johnson, Napier Villa, Wylde Green, director. Private company. The number of directors is not to be more than five; the first are B. Brooks and A. C. Johnson (both permanent). Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

High Peak Magneto Co., Ltd. (119,281).—This company was registered on December 21st, with a capital of £1,500 in £1 shares, to carry on the business of electricians, electrical engineers, electrical instrument manufacturers, manufacturers of electrical and other magnets and batteries, machinery, apparatus and devices, &c. The subscribers (with one share each) are:—F. Burks, Capstone, Mellor, Derbyshire, electrical engineer; S. Livesey, 18, Illingworth Road, Preston, traveller; R. Hogg, Infirmary Road, Blackburn, manager. Private company. The first directors are F. Burks, S. Livesey and R. Hogg; qualification, £100; remuneration as fixed by the company. Registered office, Torr Top Street, New Mills, Derbyshire.

Whisperphone Syndicate, Ltd. (119,330).—This company was registered on December 22nd, with a capital of £1,000 in £1 shares, to take over the invention known as the "Whisperphone," and to adopt an agreement with C. F. Killar. The subscribers (with one share each) are:—J. C. Grove, 82-3, Fenchurch Street, E.C., tea merchant; C. F. Killar, 82-3, Fenchurch Street, E.C., engineer. Private company. The number of directors is not to be less than two or more than five; the first are J. C. Grove and C. F. Killar; qualification, 100 shares. Registered office, 82-3, Fenchurch Street, E.C.

T. Clarke & Co., Ltd. (119,351).—This company was registered on December 23rd, with a capital of £15,000 in £1 shares (5,000 preference), to take over the business carried on at 129, Sloane Street, S.W., as "T. Clarke and Co.," and to carry on the business of electricians, electrical and mechanical engineers, &c. The subscribers (with one share each) are:—W. H. Jee, 39, Pepys Road, S.E., chartered accountant; E. G. White, Ormesby, West Heath Drive, Golden Hill, N.W., articled clerk. Private company. The number of directors is not to be less than two or more than five; the first are W. D. Clarke, E. J. Clarke and H. J. de C. Moore, each of whom may retain office while holding five shares. Registered office, 2, Gresham Buildings, Basinghall Street, E.C.

Universal Accumulators, Ltd. (119,327).—This company was registered on December 22nd, with a capital of £5,000 in 4,850 ordinary shares of £1 each and 3,000 founders' shares of 1s. each, to take over from H. de Martis the benefit of certain patents, inventions, processes and apparatus relating to the production, treatment, storage, application, distribution and use of electricity, &c. The subscribers (with one share each) are:—P. F. D. Brockman, 17, Victoria Street, S.W., barrister; W. H. Molesworth, 14, Howick Place, Westminster, S.W., civil engineer; E. H. Woods, 110, Cannon Street, E.C., civil engineer. Private company. The number of directors is not to be less than two or more than five; the first are P. F. D. Brockman, W. H. Molesworth and E. H. Woods; qualification, £5 founders' shares or £200 other shares; remuneration as fixed by the company. Registered office, 17, Victoria Street, S.W.

REVIEWS.

The Law Relating to Engineers. (A course of six lectures delivered before the Society of Engineers (Incorporated), and the Junior Institution of Engineers (Incorporated)). By L. W. J. COSTELLO, M.A., LL.B. With an introduction by the RIGHT HON. LORD JUSTICE FLETCHER MOULTON, M.A., F.R.S. Published by the above-named Societies, London. 1911. Price 5s.

When, and in what circumstances, does the electrical engineer find it necessary to have some acquaintance with the law? If he can afford it, he employs his lawyer when

any question of difficulty perplexes him; but expert legal assistance is not always cheap or readily available. Lord Justice Fletcher Moulton, in his introduction to the above volume, has put forward a strong plea for the study of the law by the engineer himself.

"In countries where law is embodied in codes, it is both easy and customary for the various classes of the professional and commercial world to know almost by heart the portions which directly relate to their calling. But in England, where we prefer the elasticity of principles to a servile adherence to any verbal embodiment of them, the task is more difficult and less frequently accomplished; and yet the English system of case law is, in my opinion, easier and safer for the sensible layman than a codified system would be. With a little care he can familiarise himself with the principles on which our Courts act, which are wide-reaching, and rest for the most part on the obvious necessities of the case viewed generally, though the consequences may be strange, and even hard, when applied to some particular and unusual state of facts. He will find himself more at home in applying principles such as these than in speculating on the interpretation which a Court will place on the specific language of a clause in a code which was probably drafted without any reference to such a case as that to which it is to be applied, and to which its language must at any cost be made to fit." The Lord Justice then proceeds to recommend the engineer to familiarise himself with the reports of decided cases by the aid of a volume like that which is now before us. How many engineers will have sufficient time on their hands to obey these precepts? The man to whom legal knowledge would be really valuable must at the present moment have his head full of much else besides the lore of the engineer. He should have a knowledge of finance, he must be a master or a leader of men. He requires a keen insight into human nature, and if his labours include dealing with town or borough councils, he must be familiar with local politics and the multifarious cranks and whims of each local Bumble. In these circumstances he may well ask: In which mental pigeon-hole shall I have room for legal knowledge?

To him who is willing and anxious to learn, the perusal of Mr. Costello's lectures should be useful.

In his second lecture he adopts the description of an engineer's duties, which is to be found in "Hudson's Building Contracts." He says, "An engineer under an engineering contract usually acts, it would seem, in several distinct capacities. He is, first of all, merely a designer or draughtsman, then, when he has received instructions to get tenders and have the work executed, he becomes an agent for the employer, and from time to time during the progress of the work he assumes the *rôle* of quasi-arbitrator between the employer and the contractor, and finally he may have to act in a fully judicial capacity under the terms of the contract appointing him arbitrator between the parties in the event of a dispute."

Not the least important part of the work is that which relates to the engineer's duties as arbitrator. He will often be required to act in this capacity; and some knowledge of legal principles is essential if justice is to be done between the parties. It may not be generally known, however, that it is competent for an arbitrator to employ a lawyer to help him to settle the terms of his award. This is a wise precaution where a case is complicated.

Mr. Costello appears to have collected and commented on all the important cases down to the most recent. His work should prove useful to those for whom it is intended.

O. C. Hawkes, Ltd.—The directors have declared the usual dividend of 5 per cent. per annum on the preference shares for the six months ended December 31st.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—A dividend of 1¼ per cent. on the issued capital stock has been declared, payable on February 1st.

Hadfield's Steel Foundry Co., Ltd.—The directors have declared a dividend on the 4½ per cent. preference shares for the half year.

CITY NOTES.

Sunderland District Electric Tramways, Ltd.

AN extraordinary general meeting of the shareholders of the above company was held on Thursday, last week, at Winchester House, Old Broad Street, E.C., Mr. H. R. Hogg presiding.

The CHAIRMAN moved the following resolution:—

That the articles of association be altered in manner following:—(*a*) Article 55 shall be cancelled; (*b*) that the following article shall be substituted for Article 55, that is to say: "The directors may from time to time, at their discretion, raise or borrow or secure the payment of any sum or sums of money for the purposes of the company, but so that the amount at any one time owing in respect of moneys so raised, borrowed or secured, shall not, without the sanction of a general meeting, exceed the sum of £250,000. Nevertheless, no lender or other person dealing with the company shall be concerned to see or inquire whether this limit is observed. The directors may raise or secure the payment or repayment of such sum or sums in such manner and upon such terms and conditions in all respects as they think fit, and in particular by the issue of debentures or debenture stock of the company, charged upon all or any part of the property of the company, both present and future, including its uncalled capital for the time being."

He said that the object of the alteration was to enable the debts owing for overdue interest to be consolidated and capitalised, Such a course was clearly to the advantage of the shareholders, otherwise they could not get any moneys paid to them for interest until the whole of the back debts had been paid in cash out of the company's income. The proposal was to get the debts consolidated and put into capital, and to do that it was necessary to increase their borrowing powers.

MR. R. TAYLER seconded the resolution, and it was carried unanimously.

Fremantle (W.A.) Tramways and Electric Lighting Board.—The *Australian Mining and Engineering Review* states that the report for the year ended August 31st shows that the income for the 12 months totalled £41,079—an increase of £3,037 on the previous year's receipts. The gross profits on the year's operations were higher than those of any previous year, amounting to £10,918, being an increase of £758. Of this sum interest on loans absorbs £5,930, while £2,642 has been allocated to sinking fund, and £1,938 to depreciation reserve, leaving a surplus of £409. The increase in the number of passengers carried during the year amounted to 341,728. A fresh agreement covering a period of five years has been entered into with the Fremantle Harbour Trust for the supply of power required to operate the pumping plant in connection with the Fremantle dock, and the additional lighting required by the trust.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—Further issue of £200,000 Deferred Ordinary Stock; £200,000 Preferred Ordinary Stock; and £200,000 5 per cent. Cumulative Perpetual Preference Stock.

Marconi's Wireless Telegraph Co., Ltd.—Further issue of 33,325 Ordinary shares of £1 each, fully paid, Nos. 466,676 to 500,000.

National Telephone Co., Ltd.—The directors on December 28th resolved to recommend at the meeting to be held on January 9th, 1912, the following dividends for the half-year ending December 31st, 1911, after payment of the dividends on the preference shares:—At the rate of 6 per cent. per annum on the preferred stock; at the rate of 6 per cent. per annum on the deferred stock, less income-tax in all cases. The transfer books will be closed from January 1st to 9th, 1912, inclusive, and the dividend warrants will be posted on the latter date.

The directors in their report for the half-year ended December 31st, 1911, dated December 30th, state that the inventory is nearing completion. It is expected that the company's claim will be ready for presentation in the early part of the year, and, in default of settlement, will, as soon as possible thereafter, be submitted to the Railway and Canal Commission, the arbitrators appointed to settle disputes in connection with the matter, between the Postmaster-General and the company. Under the heads of arrangement referred to the Postmaster-General has agreed, when required by the company, to advance £3,000,000, in order to enable the company to satisfy the claims of its debenture-stock holders. These claims should be met as early as possible, and for that purpose it is necessary for the company to go into liquidation. The board have accordingly issued notices for an extraordinary general meeting of the company, to be held immediately after the ordinary general meeting, for the purpose of passing the requisite winding-up resolutions. The procedure thus indicated does not allow sufficient time for the preparation and issue of the accounts of the company for the half-year, in accordance with its former practice. The board feel, however, that the shareholders will desire to have their usual dividends at as early a date as practicable, and, having satisfied themselves that the profits of the company for the half-year fully justified the payment of a dividend at the same rate as in recent half-years, they recommend, as stated above. The accounts for the half-year will be sent to the shareholders early in February.

Shawinigan Water and Power Co., Ltd.—The directors have declared a dividend of 1¼ per cent. for the quarter to the 31st ult., being at the rate of 5 per cent. per annum, on the common shares.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, January 3rd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	,,	22/-	..
a ,, Oxalic	,,	28/-	..
a ,, Sulphuric	,,	5/6	..
a Ammoniac Sal	,,	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a ,, ,,	,,	£30	..
a Bleaching powder	,,	£5 10	..
a Bisulphide of Carbon	,,	£18	..
a Borax	,,	£16	..
a Ferro-Silicon (50 %)	,,	£11 10	..
a Copper Sulphate	,,	£20	..
a Lead, Nitrate	,,	£25 10	..
a ,, White Sugar	,,	£22 15	..
a ,, Peroxide	,,	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Perchlorate	,,	4½d.	..
a Potassium, Cyanide	,,	7d.	..
a Shellac	per cwt.	68/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	,,	£6 10	..
a ,, Recovered	,,	£5 10	..
a ,, Lump	,,	£5 5	..
a Soda, Caustic (white 70 %)	,,	£11	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	6d.	..
a ,, Cyanide (basis 100 %)	,,	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£63	..
b ,, Wire, in ton lots	,,	£102	..
b ,, Sheet, in ton lots	,,	£120	..
p Babbitt's metal ingots	,,	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8d.	½d. inc.
c ,, Tube (brazed)	,,	10½d.	½d. inc.
c ,, ,, (solid drawn)	,,	8½d.	½d. inc.
c ,, Wire, basis	,,	7½d.	½d. inc.
c Copper Tubes (brazed)	,,	10⅝d.	½d. inc.
c ,, ,, (solid drawn)	,,	10d.	½d. inc.
g ,, Bars (best selected)	per ton	£79	..
g ,, Sheet	,,	£79	..
g ,, Rod	,,	£79	..
e ,, (Electrolytic) Bars	,,	£67	£2 inc.
e ,, ,, Sheets	,,	£84	£2 inc.
e ,, ,, Rods	,,	£72	£2 inc.
e ,, ,, H.C. Wire	per lb.	8½d.	½d. dec.
f Ebonite Rod	,,	5/8	..
f ,, Sheet	,,	4/9	..
m German Silver Wire	,,	1/11	..
h Gutta-percha, fine	,,	5/- to 7/-	..
h India-rubber, Para fine	,,	4/4	½d. inc.
j Iron Pig (Cleveland warrants)	per ton	50/6½	11d. inc.
l ,, Wire, galv. No. 8, P.O. qual.		£14	..
g Lead, English Pig	,,	£15 17 6 to £16	..
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8	2/6 dec.
d Mica (in original cases) small	per lb.	6d. to 2s.	..
d ,, ,, medium	,,	2/6 to 4/-	..
d ,, ,, large	,,	4/6 to 8/6	..
p Phosphor Bronze, plain castings	,,	11d.	..
p ,, ,, rolled bars & rods	,,	1/03.	..
p ,, ,, rolled strip & sheet	,,	1/1	..
o Platinum	per oz.	185/-	..
e Silicium Bronze Wire	per lb.	9½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	,,	£190 to £192 nom.	£12 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/4	1d. inc.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	,,	£31 2 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

STOCKS AND SHARES.

Tuesday Evening.

THE New Year has opened in more promising style than its predecessor ended. Domestic politics have been mollified by the clearing of the labour situation in the North, where the troubles appear to be working in the direction of a settlement. In the Stock Exchange there is a gamble going on, fast and furious, in the stocks and shares of the London traction companies, and speculation is following upon the wake of investment in the market for Latin-Canadian power undertakings.

Close upon the heels of the sensational boom in London General Omnibus stock there have come big rises in the issues of the Underground Electric Income bonds, and District Ordinary stock, in Central London Deferred, and Metropolitan Consolidated. So great is the interest taken in this movement that a rise of a shilling in Spiers & Pond shares evoked the sarcastic inquiry whether the company was to come into the London Electric Railway agreement or to amalgamate with Marconi's.

Underground Electric Incomes have enjoyed another big rise since last we wrote. The price touched 82, reverting to 78, which gave an advance of five points on balance. District Ordinary gained ¾, and the 6 per cent. Debenture stock promptly recovered 2 points of the interest deducted at the end of the year. A boomlet in Metropolitan Consolidated lifted the price 3. More striking than any of these, however, has been the jump of 7 in Central London Deferred, to which tardy attention was directed by the consideration that whatever benefits will accrue to the other underground systems are likely to advantage the Central London as well. But probably the spirit of gambling has a good deal to do with the rise, coupled with the fact that the market in this stock is a narrow one at all times. And, of course, the company's prospects are good enough to encourage buying when the general market is strong.

City and South London is not yet noticed; Great Northern and City Preferred remain at 22s. 6d., and for a sheer gamble may make a useful counter. East London hardened to 6½, causing a little demand for the company's Debenture stocks.

Pending distribution of the new issues, British Electric Traction Ordinary and Preference quotations are removed from the Stock Exchange Official List, but the company's Debenture issues remain, and the 5 per cent. stock is a point higher at 94½. London United Trams have improved, the Preference shares putting on ¼, while the Debenture stock at 74½ *ex* dividend is 4 points higher, with hardly any stock offering here and none at all in Bristol. Underground Electric Railway shares are a strong feature with a rise of no less than 12s. 6d. to 3½.

English Electricity Supply descriptions are quiet and steady; the few changes in the list this week are due mostly to *ex* dividend markings, and there are no features.

Congratulations to Mr. H. B. Renwick, and to the County of London Electric Supply, upon his acceptance of a seat upon the board, and of the position of managing director of that company. County Ordinary showed the biggest rise of any of the metropolitan shares last year, and—at all events from the Stock Exchange point of view—this is the most satisfactory result that management can achieve in an industry which has to depend so much upon faith, hope and patience.

Calcutta Light Ordinary rallied a further 2s. 6d., and it is now supposed that the transference of the seat of the Government to Delhi has had its full influence upon timid shareholders, and that the recovery will make further progress. Mexican Light and Power Common is a good market, with a 1½ points gain, while the Preference hardened to a lesser extent. Mexican Trams have gone up 3, things Mexican being in favour all round upon the assumption that the whole country is settling down, after its recent political ferments, to peace and prosperity under the new President.

Sao Paulo Trams have risen 9, Rio Trams put on 2½ over and above the dividend and rights, while this section exhibits pronounced strength. The long-continued absorption of the various companies' bonds is being followed, as mentioned above, by a quickening of speculative interest, and operators for the rise are devoting a good deal of attention to this section. British Columbia Electric Railway Preferred is harder.

Other improvements worthy of notice are those of ¼ in Brisbane Tramways Investment Ordinary, and of ⅜ in United Electric Trams of Monte Video Preference. These two instances, taken in conjunction with those named in the preceding paragraph, give a good idea of the widespread nature of the field covered by the demand for shares.

The feature amongst manufacturing shares is the rise of a sovereign in Telegraph Constructions, which is the first step towards recovery since the slump that followed the passing of the dividend on the Ordinary shares. The Preference, *ex* their 5s. dividend, are actually ¼ better, the gain, therefore, on the week being 10s. Castner-Kellners rose ¼ and Babcock Ordinary advanced to 6¼. Brush second Debenture at 39½ is *ex* dividend, and this makes the return on the money look remarkably high.

Marconi's compete with West India and Panama Telegraphs and London General Omnibus for pride of place in public interest. Marconis have had another big rise, the Ordinary gaining ¾, and the Preference ⅞. The latter, it is well known, take 7 per cent. cumulative dividend, then the Ordinary get 10 per cent. (when times allow), and after this the profits are divided, *pari passu*, between the two classes. There are half a million Ordinary shares issued, out of an authorised £750,000, and 227,011 Preference out of £250,000 authorised. If the Ordinary are worth their present price of 65s., it would appear that the Preference are greatly undervalued at 51s. 3d. Dealings in Canadian Marconi go on quietly on the basis of 17s. 6d. per share.

National Telephone Deferred has lost 1 on balance, the report and dividend disappointing some people who had looked for a more liberal distribution of the big profits. Dealings continue to take place, in spite of the transference effected last Sunday midnight. The position and rights of the Third Preference shares continue to excite lively discussion. The Telegraph and Telephone Market remains very steady, with prices inclining to the higher side.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for		Closing Quotations Jan. 2nd.	Rise + or Fall	Present Yield p.c.
	*	1910.	1911.			£ s. d.
Bournemouth & Poole, Ord.	10	5½	5†	7⅞ — 8⅛	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8⅞ — 9⅛	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10½ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	103 —102 xd	..	4 8 8
Brompton & Kensington, Ord.	5	10	9†	7⅞ — 8⅛	..	5 19 4
Do. 7 % Cum. Pref.	5	7	7	7⅞ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5†	3⅞ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅝ — 4⅛ xd	..	5 9 1
Do. Do. 4 % Deb.	100	4	4	93 — 96 xd	..	4 3 4
Chelsea, Ord.	5	5	4†	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	97 —100 xd	..	4 10 0
City of London, Ord.	10	7	6†	12⅝ — 13½	..	5 6 8
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 12 4
Do. 5 % Deb.	Stock	5	5	117 —121 xd	..	4 2 8
Do. 4½ % Second Deb.	100	4½	4½	100 —103 xd	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	87 — 89 xd	..	5 12 4
County of London, Ord.	10	5	4†	8⅞ — 9⅜	..	5 6 8
Do. 6 % Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	105 —108 xd	..	4 3 4
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2¼	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	+½	5 3 6
Folkestone	5	6	6†	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	9	8†	6⅞ — 7⅛	..	6 4 2
Kensington & Knightsbridge, Ord	5	9	8†	6⅞ — 7⅛	..	6 4 2
Do. 4 % Deb.	Stock	4	4	94 — 96	..	4 3 4
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	.	1½ — 2	..	3 0 2
Do. 6 % Pref.	5	6	6	4½ — 4⅞	..	6 3 1
Do. 4 % First Mort. Deb.	Stock	4	4	87 — 90 xd	..	4 8 11
Metropolitan	5	5	4†	3½ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜ xd	..	4 17 4
Do. 4½ % First Mort. Deb.	Stock	4½	4½	99 —104 xd	..	4 6 7
Do. 3½ % Mort. Deb.	Stock	3½	3½	84 — 87 xd	..	4 0 6
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	94½ — 96½ xd	..	4 13 8
Newcastle-on-Tyne	5	4	4†	3½ — 4	..	5 0 0
Do. 5 % Pref., Non-Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 18 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	9⅞ — 10⅜ xd	..	..
Oxford	5	7½	6†	6½ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10†	8 — 8½	+ ⅛	5 17 8
Do. 7 % Pref.	5	7	7	6⅝ — 7⅛	..	4 19 1
Do. 3½ % Deb.	100	3½	3½	85 — 87 xd	..	4 0 6
Smithfield Markets, Ord.	5	Nil	..	1⅜ — 1⅞	..	Nil
South London, Ord.	4	5	..	2⅛ — 3⅛	..	6 8 1
Do. 5 % First Mort. Deb.	100	5	5	98 —101 xd	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1 — 1⅛	..	6 4 5
Do. 4½ % First Deb. Stock	100	4½	4½	95 — 98	..	4 11 10
Urban, Ord.	5	5	..	⅛ — ⅜	..	..
Do. 5 % Cum. Pref.	5	5	..	2 — 2⅛	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	86½ — 88½	..	5 1 8
Westminster, Ord.	5	10	10†	7⅞ — 8⅛	..	5 19 5
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	— ⅛	4 7 10

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5½ — 5⅝	..	5 4 4
Calcutta, Ord.	5	8½	7†	6⅜ — 6⅝	+ ⅛	6 8 4
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	94 — 96 xd	..	5 4 2
Canadian Gen. El. Com.	$100	7	7†	110 —115	..	6 1 9
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	3†	¾ — 1	..	3 0 0
Do. 5 % Deb.	100	5	..	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	91 — 93	..	6 9 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	82 — 85 xd	..	5 17 8
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	91½ — 93½	..	5 6 11
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	⅛ — ⅜	+ 1/32	Nil
Do. 6 % Pref.	1	6	6	⅛ — ¼	..	8 0 0
Kaministiquia Power, 5% G. Bs.	$500	5	5	101 —103 xd	..	4 17 1
Madras, Ord.	5	..	..	2⅜ — 2¾	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	98 —100 xd	..	5 0 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	86 — 88 xd	..	5 18 8
Mexican Lt. & Power, Common	$100	4	4†	89 — 91	+1½	4 7 11
Do. 7 % Cum. Pref.	$100	7	7	108 —110	+ ½	6 7 3
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95½ — 97½	..	5 2 7
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	91 — 93	..	5 7 6
Montreal, Lt., H. and Power	$100	7	8	196 —200	..	3 10 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	..	12 3 10
River Plate, Ord.	Stock	10	..	235 —245	..	4 1 8
Do. 6 % Non-Cum. Pref.	Do.	6	6	104 —110	..	5 9 1
Do. 5 % Deb. Stock	Do.	5	5	100 —102 xd	..	4 18 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital	$100	4	5†	126 —128	+1	3 2 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	105 —107 xd	..	4 13 6
Do. 4½ % Per. Deb.	Stock	4½	4½	102½—104½	..	4 6 2
Toronto Power, 4½ % Deb.	Do.	4½	4½	98 —100	..	4 10 0
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	91— 93 xd	+1	5 7 6
Victoria Falls Power, Pref.	1	Nil	11¾d.	⅛— ⅜	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106½—108½	..	5 10 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7 — 7⅞	..	..
Do. 5 % Deb. Red.	Stock	5	5	98 —100 xd	..	5 0 0
American Telep. & Teleg., Cap.	$100	8	8½	140 —142	—2½	5 12 8
Do. Collat. Trust	$1000	4	4	93 — 95 xd	..	4 4 3
Anglo-American Telegraph	Stock	3½	3½	6⅝ — 6¾	..	5 9 6
Do. 6 % Pref.	Do.	6	6	111 —112	+ ½	5 7 2
Do. Def.	Do.	80/-	..	26 — 26⅞	+ ⅛	5 13 2
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	7	..	7 — 7⅛	..	4 16 7
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	86 — 88 xd	..	4 10 11
Cuba Telegraph	10	6	6†	10½ — 10⅝	..	5 14 3
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	3⅛ — 3⅜	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	8⅛ — 8⅜	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100½—102½	..	4 7 10
Direct United States Cable	10	4½	..	7½ — 8	..	5 12 6
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98½—100½ xd	..	4 9 7
Eastern Telegraph, Ord. Stock	Stock	7	5†	138 —141	+ ½	4 19 3
Do. 3½ % Pref. Stock	Do.	3½	3½	83½— 85½	+ ½	4 1 7
Do. 4 % Mort. Deb.	Do.	4	4	101 —103	+ ½	3 17 8
Eastern Extension	10	7	5†	13⅜ — 13⅝	..	5 1 10
Do. 4 % Deb.	Stock	4	4	100½—102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust	10	5⅞	6†	10⅜ — 11⅛	..	5 6 8
Do. 6 % Pref.	10	6	6	12⅜ — 13⅛	..	4 10 9
Great Northern Telegraph	10	18	5†	32 — 33 xd	..	5 9 1
Indo-European Telegraph	25	18	5†	56 — 58	..	5 12 1
Mackay Companies Common	$100	5	5†	80 — 83	—3	6 0 6
Do. 4 % Cum. Pref.	$100	4	4	69 — 72	—3	5 11 1
Marconi's Wireless Telegraph	1	5	..	3⅛ — 3⅜	+ ⅛	..
Do. 7 % Cum. Partic. Pref.	1	16	..	2⅛ — 2⅛	+ 5/6	..
Monte Video Telephone, Ord.	1	6	6	1⅜ — 1½	..	5 12 11
Do. 5 % Pref.	1	5	5	1⅛ — 1¼	..	5 6 8
National Telephone, Pref.	Stock	6	6†	105 —107	+1	5 12 1
Do. Def.	Do.	6	6†	130 —132	—1	4 10 10
Do. 6 % Cum. 1st Pref.	10	6	6	9⅝ — 10⅛	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅝ — 10⅛	..	5 14 3
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅛ — 5⅜	..	4 3 4
Do. 3½ % Deb.	Stock	3½	3½	99½—101½	..	3 9 4
Do. 4 % Deb.	Do	4	4	99½—101½	..	3 18 10
New York Telep., 4½% Gen. Bnds.	100	4½	4½	101 —102	+ ½	4 8 3
Oriental Telep. and Elec.	1	8	..	1⅛ — 1⅜	..	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1⅜	..	4 18 8
Do. 4 % Red. Deb.	Stock	4	4	87 — 89 xd	..	4 9 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98½—100½ xd	..	3 19 7
Reuter's	8	5	5†	83⅛ — 9½	..	4 6 6
Submarine Cables Trust	Cert.	6	6	130 —133	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	98 —100 xd	..	4 10 9
United River Plate Telephone	5	8	8	7⅞ — 7½ xd	..	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5⅝ — 5⅞ xd	+ ⅛	4 8 11
West Coast of America	2½	2½	2½	1⅞ — 1⅞	..	4 15 3
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	98½—100½ xd	+1½	3 19 7
West India and Panama Teleg.	10	1½	1½†	3⅜ — 3½	+ ⅛	3 5 4
Do. 6 % Cum. 1st Pref.	10	6	6	10⅛ — 10⅜	+ ⅛	5 12 11
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅝ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	101 —103 xd	..	4 17 1
Western Telegraph, Ltd.	10	7	6†	13⅜ — 13⅞	..	5 0 11
Do. 4 % Deb.	Stock	4	4	99 —101 xd	..	3 19 3
Western Union Tel., 4% Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	..	4 7 5

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Jan. 2nd.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Bath Trams, Pref. Ord.	1	Nil	Nil	⅜ — ½	..	Nil
Do. 5 % Pref.	1	5	5	⅞ — 1 xd	..	7 5 6
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11
Brit. Elec. Trac., Ord.	10	Nil	Nil	.. — ..	..	..
Do. 6 % Pref.	10	1½	1½	.. — ..	..	..
Do. 5 % Deb.	100	5	5	93 — 96	+1	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	..	5 8 5
Central London Railway, Ord.	100	3	3†	68 — 70	+1	4 5 9
Do. Pref.	100	4	4	84 — 86	..	4 13 0
Do. Def.	100	2	..	57 — 59	..	3 18 5
Do. 4 % Deb.	100	4	4	103 —105	+1	3 16 2
City & South London, Ord.	100	1½	1¾†	30½ — 31½	..	4 15 3
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105	..	4 15 3
Do. Do. 1908	100	5	5	103 —105	+1	4 15 3
Do. 4 % Deb.	100	4	4	101 —103	+1	3 17 8
Dublin United Trams, 6 % Pref.	10	6	6	11 — 12	..	5 0 0
Great Northern & City, Pr'f. Ord	10	Nil	..	1 — 1¼	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	⅛ — ¼	— ⅛	Nil
Do. 4½ % Deb.	100	4½	4½	73 — 78	..	5 14 8
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅜ — 2⅝	..	4 6 11
Do. 4 % Deb.	100	4	4	75 — 80 xd	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	76½ — 79½ xd	..	6 5 9
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99 xd	..	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	8 — 8¼	+ ⅛	Nil
Do. 4 % Deb.	100	4	4	72 — 77 xd	+4	5 3 11
Metropolitan Railway Consol.	100	1⅞	2†	46½ — 46¾	+⅜	2 18 10
Do. Surplus Lands	100	2½	3†	66 — 68	..	4 0 11
Do. 3½ % Deb.	100	3½	3½	91 — 93	+1	3 15 3
Do. 3½ % Pref.	100	3½	3½	86 — 88	..	3 19 7
Do. 3½ % Con. Pref.	100	3½	3½	85 — 87	+1	4 0 6
Metropolitan District Ord.	100	Nil	..	34⅜ — 35½	+ ¾	Nil
Do. 6 % Deb.	100	6	6	144 —146 xd	+2	4 2 2
Do. 4 % Deb.	100	4	4	95 — 97 xd	..	4 2 6
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3⅞	4½†	91 — 93	+2	3 10 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	+1	4 9 9
Metropolitan Elec. Trams, Ord.	1	5½	5†	3⅞ — 3¾	..	5 12 4
Do. Def.	1	Nil	..	⅛ — ⅛	..	Nil
Do. 5 % Pref.	1	5	5	3⅞ — 3¾	..	5 3 1
Do. 4½ % Deb.	100	4½	4½	100 —102 xd	..	4 8 3
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Potteries, Ord.	1	2	..	⅝ — ¾	..	..
Do. 5 % Pref.	1	5	5	¹⁵⁄₁₆ — 1	..	6 19 3
Do. 4½ % Deb.	100	4½	4½	91 — 94	..	4 15 9
South Metro. Trams, 6 % Pref.	1	6	..	⅝ — ¾	..	6 17 2
Do. 4 % Deb.	100	4	4	70 — 75 xd	..	5 6 8
Underground Elec. Railways	10	..	..	2⅝ — 2⅞	..	..
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	100	1	1½†	77 — 79	+⅝	1 5 4
Do. Power House Debs.	100	4	4	98 —100 xd	..	4 0 0
Yorkshire (West Riding), Ord.	5	Nil	..	⅛ — ¼	..	Nil
Do. 6 % Pref.	5	Nil	..	2⅜ — 2⅞	..	Nil
Do. 4½ % Deb.	100	4½	4½	78 — 83 xd	..	5 8 5

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½†	4¹⁵⁄₁₆ — 5⅜ xd	..	4 16 5
Do. 2nd Pref.	5	5	5½†	4¹⁵⁄₁₆ — 4¹⁵⁄₁₆ xd	..	5 6 8
Do. 4 % Deb.	100	4	4	93 — 95 xd	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	99½ —101½ xd	..	4 8 8
Do. 5 % Deb.	100	5	5	99 —101	..	4 19 0
Auckland Trams, 5 % Deb.	100	5	5	102 —105 xd	..	4 15 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅝ — 11⅜	..	5 5 6
Do. 4½ % Deb.	100	4½	4½	96 — 98 xd	..	4 11 10
Do. 5 % 2nd Deb.	100	5	5	96½ — 98½ xd	..	5 1 6
Brisbane Trams Invs., Ord.	5	8	8†	8⅜ — 8⅝	+ ⅛	4 10 2
Do. 5 % Pref.	5	5	5	4⅝ — 5¼	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	101 —104 xd	..	4 1 7
B. Columbia Elec. Rly., Def.	100	8	8†	136 —141	..	5 13 6
Do. Pref. Ord.	100	6	6	118 —122	+1	4 18 4
Do. 5 % Pref.	100	5	5	109 —112	..	4 9 5
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	104 —106	..	4 4 11
Do. 4½ % Con. Deb.	100	4½	4½	102½ —104	+ ½	4 6 7
Calcutta Trams, Ord.	5	6	..	5½ — 5¾	..	5 4 4
Do. 5 % Pref.	5	5	5	4¾ — 5⅛ xd	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	100 —103 xd	..	4 7 5
Cape Electric Trams	1	Nil	2½†	⅞ — 1	..	4 0 0
City Buenos Aires Trams (1904)	5	5	5	5⅝ — 5¾	..	4 5 1
Do. 4 % Deb.	100	5	5	95 — 98 xd	..	5 2 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	102 —105	..	4 15 3
Kalgoorlie Elec. Trams	1	Nil	..	⅞ — 1	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94	..	5 6 5
Do. 6 % B Deb.	100	5	6†	58 — 62	..	8 1 4
La Plata Elec. Trms, Prf.	1	6	6	⅜ — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1½ xd	..	4 16 0
Do. 5 % Deb.	100	5	5	96 —100	..	5 0 0
Madras Elec. Tr. (1904), Deb.	100	5	5	93½ — 96½ xd	..	5 3 8
Manaos Trams & Lt., 1st Deb.	100	5	5	90½ — 92½ xd	— ½	5 8 1
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½ —102½	+ ½	4 17 7
Mexico Trams Com.	$100	7	7†	124 —126	+3	5 11 1
Do. Gen. Con. 5 % Bonds	..	5	5	98½ —100½	+ ½	4 19 6
Do. 6 % Bonds	100	6	6	100½ —102½ xd	+ ½	5 17 1
Para Elec. Rlys. & Lt., Ord.	5	10	10†	6⅞ — 7¼	..	6 18 0
Do. 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	97½ — 99½	..	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	¾ — 1 xd	..	2 10 0
Do. 5 % 1st. Deb.	100	5	5	99 —101 xd	..	4 19 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5½ — 5¾ xd	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	96 — 99 xd	..	4 11 10
Rio de Janeiro Trams	$100	4½	5†	116½ —117½ xd	..	3 16 7
Do. 1st Mort. 5 % Bonds	..	5	5	100⅜ —101⅜ xd	..	4 18
Do. 5 % Mort. Bonds	100	5	5	97¼ — 98¼	+1	5 1
Sao Paulo Tram, Lt. and P.	$100	10	10†	193 —197	+9	5 1
Do. 5 % 1st Deb.	$500	5	5	101½ —103½	+ ½	4 16
Singapore Trams, 5 % Deb.	100	5	5	81 — 84	—1	5 19 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96½ — 97½	..	5 2 7
Un. Elec. Trams Monte Video	5	6	7	5⅝ — 5¾ xd	..	5 2 2
Do. 6 % Pref.	5	6	6	5¹⁵⁄₁₆ — 5¹⁵⁄₁₆	+ ⅛	5 10 4
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	⅝ — ¾	..	..
Do. 6 % Pref.	1	9	6	⅞ — 1	..	7 2 2
Babcock & Wilcox	1	26	24†	6 — 6¼	+ ⅛	4 8 2
Do. Pref.	1	6	6	1⅜ — 1½	..	4 0 0
B.I. & Helsby Cables	5	10	8†	6⅝ — 7⅛	..	7 0 4
Do. Pref.	5	6	6	5¾ — 6¼	..	4 16 0
Do. Deb.	100	4½	4½	101 —103 xd	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	94 — 97	..	4 12 9
British Westinghouse, Pref.	3	Nil	..	1 — ⅛	..	Nil
Do. Deb.	100	4	4	54 — 57 xd	..	7 0 4
Do. 6 % Prior Lien	100	6	6	100 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — ¼	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — ¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	37 — 42 xd	..	10 14 4
Callender's Cable	5	15	10†	9 — 9¼	..	7 13 10
Do. Pref.	5	5	5	5 — 5¼ xd	..	4 15 3
Do. Deb.	100	4½	4½	99 —101 xd	..	4 9 1
Castner-Kellner	1	17½	20	8⅝ — 8¾	+ ⅛	4 13 4
Do. Deb.	100	4½	4½	104 —106	..	4 3 4
Crompton & Co.	3	Nil	Nil	⅛ — ¼	..	Nil
Do. Deb.	100	5	5	58 — 63 xd	..	7 7 1
Dick, Kerr	1	5	..	⅜ — ⅝	..	5 14 3
Do. Pref.	1	6	6	1⅛ — 1⅜	..	5 12 11
Do. Deb.	100	4½	4½	92½ — 95½ xd	..	4 14 3
Edison & Swan, A, £3 paid	5	Nil	..	⅜ — ½	— 1/32	Nil
Do. fully paid	5	Nil	..	1¾ — 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74 xd	..	5 8 1
Do. 5 % Second Deb.	100	5	5	77 — 80	..	6 5 0
Electric Construction	2	Nil	2½†	⅜ — ⅝	..	..
Do. Pref.	2	7	7	1⅜ — 1⅝	..	7 9 4
Greenwood & Batley, Pref.	10	7	7	7½ — 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8⅜ — 9½ xd	..	5 8 1
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11⅞ — 12⅜	..	5 18 10
Do. Pref.	5	4½	4½	4¹⁵⁄₁₆ — 5⅛	..	4 5 11
Do. Deb.	100	4½	4½	104 —106	..	4 4 11
India-Rubber, G. & T.	10	10	..	10 — 12	+1	..
Do. Pref.	10	5	5	9½ — 10½ xd	+10/-	4 17 7
Telegraph Construction	12	20	10†	84 — 86	..	6 13 4
Do. Deb.	100	4	4	99½ —101½ xd	..	3 18 10
Willans & Robinson	1	Nil	..	⅛ — ¼	..	Nil
Do. Pref.	5	Nil	..	⅛ — ¼	..	Nil
Do. Deb.	100	4	4	58 — 63	..	7 2 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

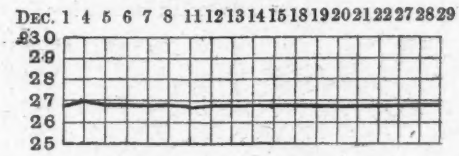
The yields are calculated upon the dividends paid for 1910.

Bank rate of Discount 4 per cent., September 21st, 1911.

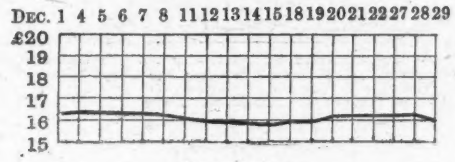
METAL MARKET.

Fluctuations in December.

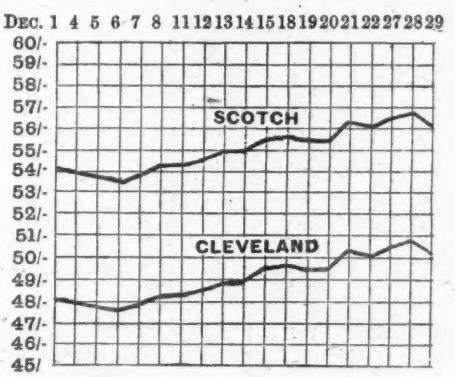
SPELTER (G.O.B's.).



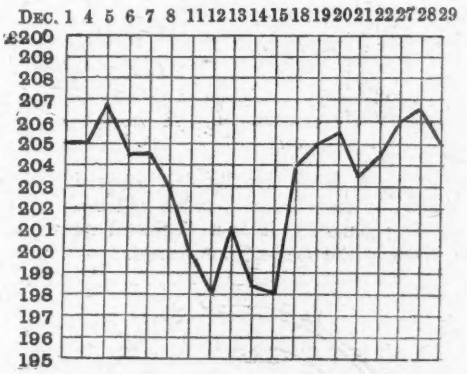
LEAD (ENGLISH).



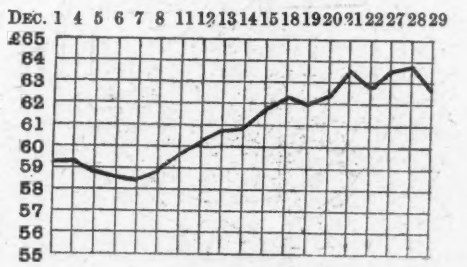
IRON.



TIN.



COPPER (G.M.B's.).



Horsham Lighting.—The U.D.C. has decided to light the Oakhill district by means of electric lamps.

A Committee has been appointed to consider the advisability of erecting a refuse destructor at the electricity works.

STREET LIGHTING.

By H. F. J. THOMPSON, Chief Assistant Engineer, Battersea Borough Council Electricity Department.

The question of public street lighting is usually viewed either from the standpoint of an advertisement for the type of illuminant used, or from that of mere utility. The gas companies, when they get the opportunity to light an important thoroughfare, almost invariably consider it a question of advertisement, but it has been suggested that that is to make up for their sins in the side streets. However, whether that is correct or not, it is certainly advisable to have a good light in the main streets, where pedestrian and vehicular traffic is the densest, and as the tradespeople often follow the lead, a well-lighted street results, which has the effect of producing prosperity, as the purchasing community are always attracted by a good light.

In the case of electricity, the scheme decided upon usually depends on the feeling of the authority controlling the particular streets. If they decide on an advertisement, they must, of course, have a high degree of illumination, in fact, excessive lighting, and yellow chemical flame arc lamps, with dioptric globes, are then generally used. On the other hand, if they wish only to light the streets sufficiently for all practical purposes, the metallic-filament lamp meets all requirements.

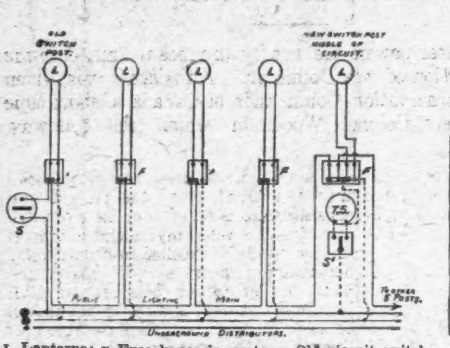
The principal streets of most large towns have for some time been lighted by means of the old open type white arc lamp, and, therefore, it is only a question of conversion to either flame arc lighting, or metallic-filament lamps; as the tendency at present appears to be towards the latter method, the writer proposes to confine his remarks to that class of lighting.

In districts supplied with direct current from a three-wire system, it is usually found that the arc lamps are arranged in series of 10 connected across the outer conductors of the system. In that case the easiest method of conversion is to arrange for one high-candle-power, or a group of low-candle-power, low-voltage lamps on each post, and to run these posts in series in the same manner as the arc lamps. This system, however, has many drawbacks when compared with a group of high-voltage lamps on each post, arranged in parallel between the outers and middle wire of the system. With the series method it is found that it is a difficult matter to maintain an equal pressure across the supply terminals at all the posts connected in series, due to the varying resistances of the lamps, and also some automatic device has to be provided to cut in a substitutional resistance or spare lamp in case of lamp failures. When a group of small lamps on each post is decided upon, in preference to one large lamp, in order to prevent a post being in darkness, the automatic device usually only takes care of one lamp, and then in the event of a further failure an increased pressure is put on the remaining lamps on that post, often resulting in their destruction, and the extinction of the circuit.

It therefore appears to be advisable to connect the lamps in simple parallel, although this obviously necessitates the provision of a service to each post from the neutral conductor, but this is compensated for by the advantage of being able to fuse each post separately and thus have only one post affected, instead of the whole series of lamps, in the event of a fault occurring above ground.

It is assumed that the metallic lamps are to take the same amount of power as the arc lamps, and it will, therefore, be necessary to feed the old arc lighting circuits in the middle, if the current density in the underground public lighting mains is to be kept the same as hitherto. This is also advisable in order not to increase the number of switching points. This arrangement has the advantage that a faulty section of the cable can be cut out and all lamps kept in lighting in case of a fault on the underground mains. The suggested arrangement of connections is shown in fig. 1 (p. 34), where the full lines represent the original arc lighting cables, and the broken lines the additional services, &c. A D.P. fuse-box suitable for fixing in each post and provided with a looping-in terminal on one pole, so that a faulty cable can be disconnected, is shown, as well as the complete gear for the new switch posts.

The question as to the type of lantern to use should also receive very careful consideration, and doubtless most



L, Lanterns; F, Fuse boxes in posts; S, Old circuit switch and fuse; S', New hand switch; T.S., time switch.

FIG. 1.

engineers will specify the minimum illumination to be obtained on the street surface with lamps of specified wattage and efficiency, in addition to the general construction of the lanterns. The type of lantern adopted at Battersea, which has given a very good illumination, is shown in fig. 2. It is of Mr. Haydn Harrison's standard type, with slight modifications, and is arranged to take four lamps, two of which are automatically switched out at midnight by means of a special switch placed in each lantern. This enables the candle-power of each post to be reduced to half at midnight,

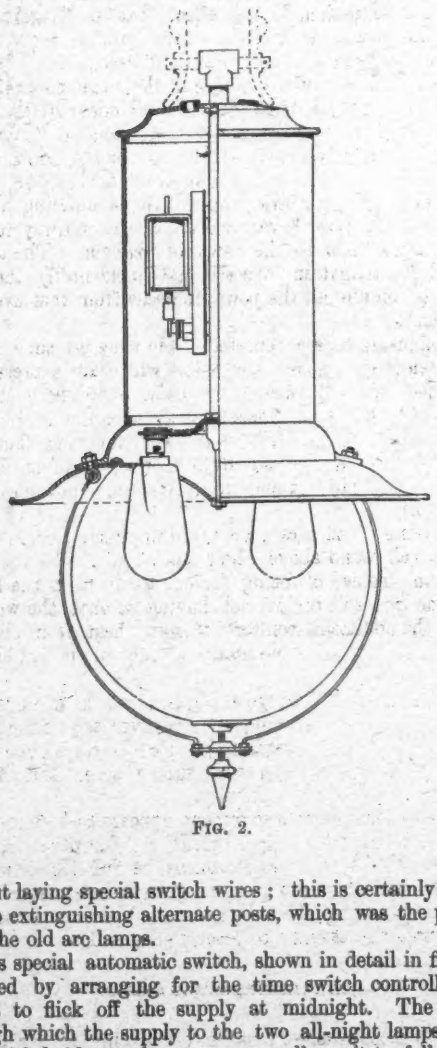
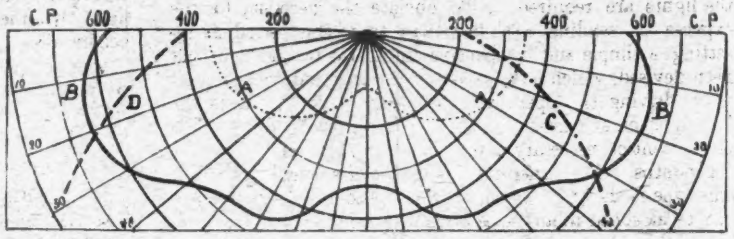


FIG. 2.

without laying special switch wires; this is certainly preferable to extinguishing alternate posts, which was the practice with the old arc lamps.

This special automatic switch, shown in detail in fig. 4, is operated by arranging for the time switch controlling the circuit to flick off the supply at midnight. The coil A through which the supply to the two all-night lamps passes and which holds up the core B, now allows it to fall, and in doing so it moves the commutator switch C and cuts out the two half-night lamps, so that when the supply is resumed only two lamps come into lighting. A distinct feature of this switch is that the commutator is moved only when the supply is off, and therefore any possibility of sparking is eliminated.

The four lamps are fixed to a frame supported by an insulated anti-vibrator, and when the lamps are removed from the holders the case of the lantern can easily be lowered to inspect the automatic switch and wiring.



A, C.P. of four tungsten lamps, 460 watts; B, C.P. of four tungsten lamps in a Harrison lantern; C, C.P. of 500-watt open arc lamp; D, C.P. of 850-watt flame arc lamp.

FIG. 3.

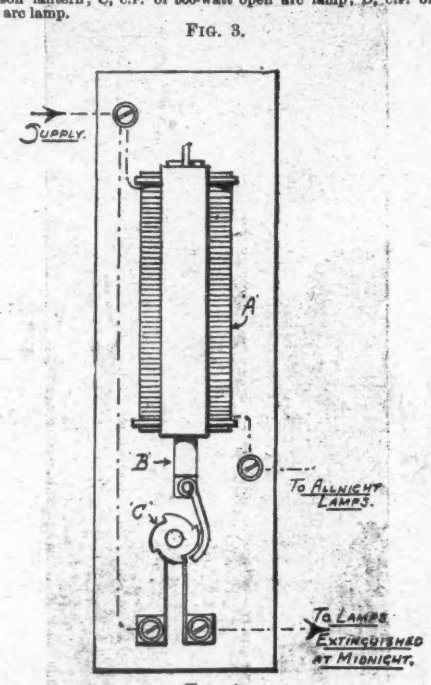


FIG. 4.

Curve B, fig. 3, shows the illumination produced by the reflectors fixed to these lanterns, and it will be seen that, for street lighting purposes, it is a distinct improvement on Curve C given by the open-type arc lamps.

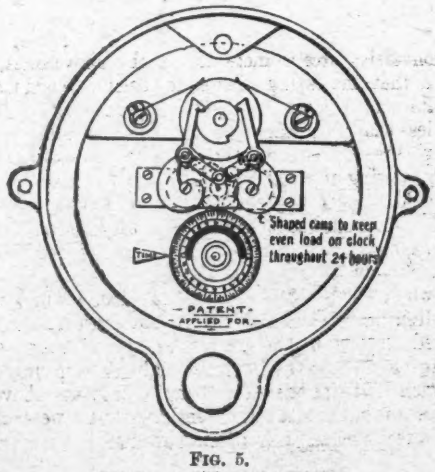


FIG. 5.

The question whether the switching of the circuits shall be effected by hand or automatically depends on local circumstances; but where the district is extensive, it undoubtedly pays to adopt the latter method. These time

switches are usually operated by clockwork and can be rewound, from the outside of the case, by the lamp cleaners on their periodical rounds just as they doubtless wind their own domestic clocks; but the writer has found that it is not advisable to arrange for these men to do the setting for switching "on" and "off," and in any case this would have to be done at least once a week, and then a variation of approximately 15 minutes would occur from the actual time the lights are required. To obviate the necessity for the expense of sending a skilled man to do this periodical re-setting, a simple and inexpensive automatic arrangement has been devised, which merely consists of toothed wheels positively driving the operating mechanism, and it effects the switching on at sunset and off at sunrise every day. The only attention necessary is to move a small lever once every six months. The general arrangement of a small switch of this type is shown in fig. 5, but the automatic setting gear can be attached to any type of time switch.

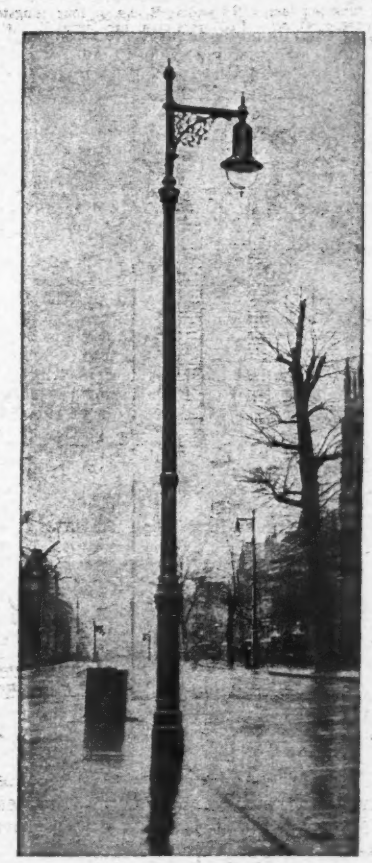


Fig. 6.

By converting arcs to metallics on the above lines, it will be found that the saving effected in attendance and maintenance costs will, in most instances, repay the cost of conversion in less than two years, and therefore, where open-type arc lamps are still in use—due to the lighting authority probably waiting until the flame arc lamp has reached finality—it would appear to be advisable to change to metallics forthwith, especially as it would be an easy matter to revert to arc lighting in the main thoroughfares, if desired, when the cost of conversion has been repaid.

The whole of the 432 open-type arc lamps which were in use for lighting the main streets of Battersea have now been converted in the above manner (a typical example being shown in fig. 6), and the improved lighting is giving general satisfaction. It was therefore thought that the above notes might be of interest to other engineers who were contemplating alterations in their public lighting.

Leicester Electricity Supply.—The T.C. has been recommended to reduce the charge for electricity for cooking and heating purposes to ½d. per unit.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

Canada's water powers are not by any means limited to the southern portion of the Dominion. An address was given before the Conservation Commission of Canada a short time ago, by Lieut.-Colonel Wood, in which the following occurs:—

Most of Labrador is a rocky tableland, still rising from the depths, with some old beaches as much as 1,500 ft. above the present level of the sea. The St. Lawrence seaboard is famous for its rivers and forests. The Atlantic seaboard has the same myriads of islands, is magnificently bold, is pierced by fjords unexcelled in Norway, and crowned by mountains higher than any others east of the Rockies. Hamilton inlet runs in 150 miles. At Ramah the cliffs rise sheer 3,500 ft. and more. The Four Peaks, still untrodden by the foot of man, rise more than twice as high again, and the coloration of every splendid line adds beauty to the grandeur of the scene. Inland there are lakes up to 100 miles long, big rivers by the score, deep cañons and foaming rapids, to say nothing of the countless waterfalls, of which the greatest equals two Niagaras.

This vast country is accessible by sea on three sides, and will soon be accessible by land on the fourth. It lies directly halfway between Great Britain and our own North-West, and is 1,000 miles nearer London than New York is. Its timber, mines and water-power will be increasingly exploited.

Labrador is about eleven times as large as England.

The North-Western regions on the Peace and Mackenzie Rivers have water-power, too, and plenty of it. Twelve falls are said to be capable of yielding 300,000 H.P. Two falls, on the Hay River, about 2 miles apart, are reported to be larger than Niagara.

A statement certainly at variance with most people's notions on the subject has recently been made by the Conservation Commission, to the effect that at Niagara Falls there is now available only about one million more horse-power, and that most of this is already leased.

Some details are now available of the water-powers which Manitoba will possess under the new boundary limits. The head of water at various points varies from 96 ft. down to 10·6 ft., and the power from 1,290,000 to 147,000 H.P.

The total H.P. available is estimated at 6,779,000.

At Bassano, in Alberta, the C.P.R. is building a large dam across the Bow River, and an electric railway is to be built from the dam to the town of Bassano. The dam is intended for irrigation purposes, and, incidentally, the town expects to obtain all the power it needs from that available at the dam.

It is amusing to see reported, from time to time, in the English electrical papers, the views which are expressed on the subject of glass screens in front of tramcar drivers. They always seem to be considered dangerous, and, in snowy weather, liable to obstruct the drivers' view. In Canada it would be impossible for the drivers of tramcars to perform their duties in winter time unless they were protected from the weather.

The fronts of all cars here are completely closed in, and have glass all round above a height of about 2 ft. 6 in. The motorman, instead of being frozen to death, is practically inside the car, and besides not having to face the weather, he gets the additional comfort of some heat from the coal stove, which is another necessary adjunct in all cars here in the cold weather.

The glass very seldom gets broken, and as to snow—the driver keeps a broom handy, and whenever the accumulation of snow on the glass obstructs his view he steps outside and brushes it off, which is a very simple, cheap and effective way of getting over the difficulty.

The new Dominion Government appears to be favourably inclined towards the improvement of Toronto's Harbour facilities, and, if present expectations be fulfilled, it will not be a great while before large ocean-going vessels come straight to this busy and rapidly-growing city, whose importance as a trade centre will thereby be greatly enhanced.

"Hylo" Lamps.—It may interest some of our readers to learn that the private cabin of the Princess Royal on the ill-fated ss. *Delhi* was equipped with economical ("Hylo") turn-down lamps, which were supplied by Messrs. W. Geipel & Co.

PROCEEDINGS OF INSTITUTIONS.

An Automatic Starting Device for Asynchronous Motors.

By N. PENSABENE-PEREZ, A.M.I.E.E.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS *at Birmingham, December 13th,* 1911.)

SUPPOSE a suitable arrangement of resistances and moving contacts, controlled by centrifugal forces, cutting out the resistances from the phases of the motor while the latter increases in speed at starting. Assume that by providing a sufficient number of contacts, the resistances are cut out gradually, and that the centrifugal forces moving the contacts are opposed by the action of a spring, which brings back the contacts, and thus inserts all the resistances in circuit, as soon as the speed falls below a certain minimum value.

The author shows that, in order to keep the rotor, and, in consequence, the stator current constant in the starting period, the resistance of the starter must be varied according to a certain relation.

In other words, there must be equilibrium between the centrifugal forces, the tension of the springs, and the friction for any position corresponding to a certain resistance and speed given by the above-mentioned formula. The difficulties in the way of the proper solution of this problem are greater than would appear at first sight.

The following is a device, designed by the author, which would fulfil the above conditions. The resistances for a three-phase wound rotor consist of flat strips wound as three separate independent discs and insulated with asbestos paper. These three discs are clamped together with two cast-iron end discs, on the periphery of which is pivoted a bar carrying three arms with three contacts sliding along the polished face of the resistance discs. We may earth the inner extremity of these three resistances and connect the three rotor phases to the other extremity, so that when the contacts move outwards they gradually cut out the resistances; in this case the weight of the arms can be used to help the motion of the contacts. When the rotor phases are connected to the inner rings, of course, this weight will oppose the motion; this arrangement is preferable, as will be seen later. It is this case we will consider in the following:—An auxiliary weight is provided which, through a variable ratio gear, as shown in fig. 1, produces by centrifugal force the motion of the arms against the tension of the spring.

The shape of the gear is shown in fig. 2. The fingers A B engage at normal running conditions, and the ratio being thereby increased, the speed can go down to any prearranged value before any backward motion can take place.

When experimenting with the apparatus described, serious faults were found to exist, and were at first very difficult to explain and eliminate. As soon as the primary switch was closed, the stator

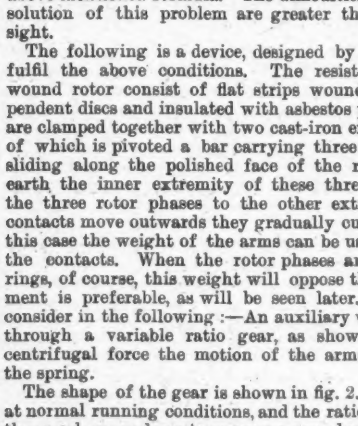


FIG. 1.

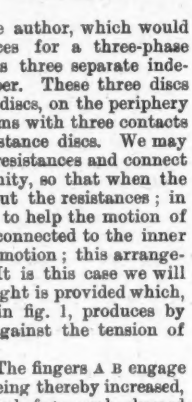


FIG. 2.

current reached the maximum calculated, but this gradually went down considerably below the constant value prearranged, after which, if the load exceeded a certain value, the motor stopped accelerating, and if the load was reduced, the motor suddenly went up to full-load speed after a considerable rush of current. To understand what was taking place, we must introduce another factor—that is, the difference between the static and dynamic friction, or what can be termed the sticking action.

In order to reduce the increase of speed necessary to overcome the difference between static and dynamic friction, the ratio between the spring tension and the static friction must be as large as possible. As soon as the motion is initiated, the friction drops to the dynamic value, and there is an excess of motive effort, and, in consequence, acceleration until the contacts have assumed that position in which the spring balances the action of the centrifugal forces. In this position the contacts stop again. We may assume that the time taken by the contacts to move and stop again is so small as to warrant our considering the speed of the motor constant in this period. The position, then, the contacts are going to take can be easily fixed, being the position for which there is equilibrium at such a speed in the case of dynamic friction. The process continues in the same way. Now, it is obvious that, while the contacts are stationary on the disks, and the speed increases, the current and the torque of the motor go down, and may fall to such a value as to reach the magnitude of the load torque, in which case the motor stops accelerating.

When the increase in speed necessary to overcome the static friction exceeds a certain limit, it is obvious that the acceleration of the contacts and arms, &c., may be so great as to store enough kinetic energy in the system as to make the contacts overstep the angle of equilibrium corresponding to the speed of the motor. Near synchronism this danger is more pronounced, and large kicks of current were observed, showing that all the resistances were cut out too soon. All these troubles have been practically eliminated by reducing the friction as much as possible and increasing the spring tension.

The time necessary for starting a motor depends on the magnitude of the accelerating torque (that is, the difference between the motor torque and the load torque) and the kinetic energy stored in all the masses driven by the motor at full speed. In any motor controlled by an ordinary starter, the current and the torque fluctuate between a maximum and a minimum value, and this fluctuation is the greater the smaller the number of contacts in the starter. In the case of the automatic starter, the number of steps being very great, the current would drop to 80 per cent. or 75 per cent. of the maximum allowed, and then remain practically constant until the machine reaches full speed. For this reason, the time taken by the automatic starter, as described, is much less than the time taken by a motor controlled by an ordinary commercial starter. Moreover, the losses in the resistance are less. It is to be noted that besides the asbestos paper between turns of the spiral German silver strip no other insulating material is used. This can only be achieved by making the outside cast-iron rings, which clamp each resistance ring, the neutral of the starter, which, therefore, is earthed. The inside rings of the disks are connected to the end of the rotor phases. The weights of the contacts and arms act against the motion. Although this is an inconvenience, the little disadvantage is amply repaid by the simplicity and soundness of the construction.

In the case of a 300-H.P. induction motor made by the Electric Construction Co., Ltd., fitted with a self-contained automatic starter, and designed to start the motor against one-third of full-load torque, this starter is fixed on the arms of the spider, and, the three phases being connected to the outside of the disks, the contacts move outwards. A starter of this description is specially suitable for high-voltage induction motors, as it entirely avoids any danger of large rush of current at starting due to carelessness in cutting out the starting resistance. These large fluctuations of current, as is well known, are very often responsible for surging effect, producing breakdown in the high-tension windings.

Institution of Electrical Engineers.

NEWCASTLE LOCAL SECTION.

ON December 11th, MR. C. S. VEREY-BROWN delivered his address as chairman of the Section. He expressed a hope that the proposed new rules, which, amongst other matters, would have to be considered during the present session, would be approached in that spirit which should animate everyone who desired to see the Institution strengthened, and the object for which it was established safeguarded. He regretted that Students did not take a more prominent part in the discussions at Newcastle, but he was pleased to say that arrangements had been made to form a students' section.

Turning to the progress which had been made locally in connection with the supply of electricity, he pointed out that in the short space of 10 years the capacity of generating plant in public power stations had risen from 14,600 to 137,000 KW., the output in units had increased from 4½ millions to 225 millions, and the capital invested had grown from £660,000 to £5,000,000.

During the last 10 years a prophecy of his own, viz., that £10,000,000 would be spent in electrical plant during the following 10 years had been fulfilled, when one considered the amount spent by the various manufacturing interests represented in the railways, shipyards, collieries, &c. He could not hold out the same hope of a million a year for the next 10 years. He could, however, foresee large increases in the direction of railway electrification, and electrochemical and metallurgical processes, which required a cheap and reliable source of supply. Turning to the training of the electrical engineer, he drew attention to the extraordinary number of subjects upon which an electrical engineer might be called to express an opinion, some of them quite alien to the application of electrical science. The subjects ranged from a knowledge of law and accounts to giving an estimate of the annual cost of energy used by an electric motor driving a brickyard as against suction gas with anthracite coal supplied at "next to nothing" per ton. The average man, outside the electrical engineering profession, had not the faintest idea as to the educational training that most electrical engineers had to go through.

The electrical engineer ought necessarily to occupy himself with nearly all questions involved in mechanical engineering, in order to be able to follow the profession of an electrical engineer.

The first element of an electrical engineer's training should be a sound general education, with some knowledge of one or more modern languages, and a good grounding in mathematics.

The student was usually taken from school at 16 to 18 years of

age, and put to either a technical college or a workshop. Having finished a two or three years' course at either of these establishments, he was then launched on the world as a budding electrical engineer. During the whole period of this training, however, little or no attention could be given to what one might term the general knowledge of business requirements, which would be found so necessary later on. He pleaded for a longer period of training, say, not less than four years, and he thought that the remedy for the overcrowded state of the profession was in the hands of those who were in it now.

With regard to examinations, he thought that little or no account could be taken in them of the student's ability to express his ideas in writing. An examination for any particular purpose was not a final test as to a student's ability. Another important qualification was that of being able to express one's self in such terms, in connection with electrical nomenclature, that the ordinary lay mind could, as a rule, grasp the meaning. Ability either to buy or sell, depending upon the direction in which his energies were employed, was an important factor, and another was ability to be able to deal with his fellow man according to the circumstances of the case. The real education of an engineer only commenced when he received the fruit of his first week's work, and his whole career was one long process of training and development.

DR. W. M. THORNTON, proposing a vote of thanks to Mr. Vesey-Brown, strongly advised students not to take up electrical work too early, but to get a thorough grounding in mechanical engineering. Examinations could not be avoided altogether, but nowadays a man was rated not only on the results of written examinations, but on the work which he had done throughout the session, and the results of his practical work in the laboratory. It was usual for the written papers to carry about 40 per cent. of the total marks for the session, so that a man whose course and practical work were perfect would probably have to do very badly indeed in the written papers not to pass.

The Röntgen Society.

AT the meeting on December 5th a lecture was delivered by PROF. W. H. BRAGG, of Leeds University, on "The Energy of the X-ray." He pointed out that many of the phenomena of light appeared to fit better into the corpuscular theory than into the wave theory, and this was equally true of the X-rays. It was the function of the X-rays to produce ionisation in the air through which they passed, and to excite swiftly moving electrons in the material upon which they struck. When the ions were made by the passage of rays in a gas, the electrons went away from the atoms with comparatively small speed, like fruit dropping from a tree which had been struck. On the other hand, electrons caused by the X-rays impinging on a solid substance were possessed of great speed and had the power of causing phosphorescence. He regarded the X-ray as something which kept its energy to the end, which did not spread in transmission, and which, on striking an atom, imparted the whole of its energy to one electron. It was this electron and not the X-ray—an electron within and belonging to the human body in the case of a radio-therapeutic application—which did the work.

In the course of the subsequent discussion, Mr. W. Duddell said that if he understood Prof. Bragg aright, he regarded the transference of energy by means of the X-rays, not as a general radiation out into space so that the energy fell off at any point according to the "square" law, but as a form of transmission in which, by putting energy in at one end, practically the whole of the energy came out at one point at the other end. It was necessary, therefore, to imagine the transmission of energy through the ether along a definite line without any sideway loss, and the difficulty was to understand what possible mechanism there was in the ether to transmit energy in that form.

The Physical Constants of Aluminium.

THE FARADAY SOCIETY finished their session on December 6th with a very full programme of papers; of these, some two or three were of general technical interest. Dr. J. A. Harker, F.R.S., was in the chair.

DR. F. J. BRISLEE, of the British Insulated and Helsby Cables, Ltd., gave an account of his recent determinations of the density and coefficient of expansion of aluminium. It may seem strange that these physical constants of so important a metal as aluminium should still remain uncertain, but it is largely accounted for by the fact that earlier determinations were made on specimens of doubtful purity and unknown composition, while the present measurements were made on the remarkably pure commercial brands now supplied by the British Aluminium Co., Ltd., and the Société Electrométallurgique Française. The samples used in these measurements contained about 99½ per cent. aluminium; the impurities were chiefly iron and silica, of which about ¼ per cent. of each was present.

The specific gravity was determined upon the cast metal, upon hard-drawn ⅜-in. rod, soft annealed ⅜-in. rod, and also upon remelted aluminium, and the measurements were made both by the ordinary method of weighing in air and water, and by the displacement method, which was employed for fine wire. The corrected results of a large number of determinations averaged 2·708 for cast metal, metal on which a large amount of work had not been done, and 2·705 for hard-drawn rod. It is strange that the value for hard-drawn rod should be lower than for the cast metal, but some few measurements on metal which had been worked gave a value as high as 2·72. The density of remelted aluminium was found to be 2·68. This drop in density on remelting was stated in the discussion to be due to absorption of gases, either nitrogen or hydrogen. It is well known that many molten metals absorb gases and retain them in rapid cooling, but it is not usually realised how disastrous the presence of a small quantity of gas may be in many instances. Dr. Seligman pointed out that there had recently been quite an epidemic of over-heated aluminium on the market, carrying quantities of gas, and Dr. Harker stated that the National Physical Laboratory, realising the importance of the matter, was carrying out experiments on the absorption of gas by aluminium. It seems probable that the low value for the density usually given in the text-books, namely, 2·65 to 2·67, is to be ascribed to the presence of gases in the samples tested, so that Dr. Brislee's figures are seen to be of real importance.

The density of rolled sheet, which is of great technical importance, does not appear to have been determined by Dr. Brialee, but it was given by Dr. Seligman, as a result of his own determinations, as 2·727.

The coefficient of linear expansion was measured directly by determining the increase in length of a rod of the metal, about 1 metre in length, when heated from 10° C. to 100° C. For details of the apparatus used, and of the corrections allowed for, reference must be made to the original paper; it will suffice here to give the formulæ from which variations in length at any temperature can be calculated :—

Hard-drawn aluminium.	Annealed aluminium.
$L_t = L(1 - 0{\cdot}00002432t)$.	$L_t = L(1 - 0{\cdot}00002454t)$.

The Benkö Primary Battery.

SOME of the latest types of this battery were exhibited at the meeting of the FARADAY SOCIETY by MR. W. R. COOPER. Its original form was described in our issue of June 2nd, 1911, and it will be remembered that its essential feature is the use of a porous carbon electrode, through which the electrolyte (sodium bichromate) flows under pressure, thus reducing polarisation to a minimum.

In the new form of cell exhibited, the electrolyte passes through the carbon by diffusion, very concentrated electrolyte being introduced into the outer, and water into the inner compartment; or fairly strong sulphuric acid may be used in the outer and strong bichromate solution in the inner compartment. In either case the solution round the zinc is only very slightly acid, and a zinc efficiency of 90 per cent. is claimed.

The diffusion type of cell cannot be used to give current continuously like the pressure type. A cell weighing 5 lb. (excluding electrolyte) and measuring 6¾ in. long, 1½ in. wide and 6¼ in. high gave a current for 8 hours daily as follows :—

1st day	0·25 to 0·24 amp.
2nd ,, ...	,, ,, ,, ,,
3rd ,, ...	fell to 0·22 ,,
4th ,, ...	,, ,, 0·20 ,,
5th ,, ...	fell off seriously.

A current of 0·25 ampere is regarded as normal for the size of cell, in which the electrolyte amounts to about 200 c.c. and contains 170 grs. of sodium bichromate and 250 c.c. of sulphuric acid per litre. By using a more concentrated electrolyte the E.M.F. (2 volts) can be maintained longer.

The pressure type of cell, in the case of a unit weighing 10 lb., gives a steady current up to about 25 amperes at 1·5 volts.

The diffusion cells are likely to prove very useful in telegraphy, motor-car lighting, and for hand-lamps. Probably, too, a successful miners' lamp will be produced, capable of burning for two periods of eight hours each on consecutive days. This has already been accomplished in the laboratory, but it remains for such lamps to be put into actual use.

Notes on Standards for Electrical Machinery.

By DR. ROBERT POHL, M.I.E.E.

(*Discussion on paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *at Leeds, December 6th*, 1911. *For abstract of the paper, see* ELECTRICAL REVIEW, *December 29th*, 1911.)

MR. WALTER EMMOTT said that Dr. Pohl's speeds, outputs and sizes of machines agreed pretty well with those of manufacturers with whom he had no hesitation in placing orders. Something should be done as early as possible. Their competitors in Belgium, France and Germany had a lower standard of output and lower rating all the way through. If they had a British standard specification on the lines suggested the difficulty would be gone.

MR. H. H. WRIGHT said he thought an organisation already existed which could undertake this question of standardisation—viz., the British Electrical and Allied Manufacturers' Association. Unless they could get all the manufacturers to take it up, standardisation was worth nothing. The German specification as to the commutation of continuous-current machines was too lenient. He was glad to see that Dr. Pohl recommended a flash test of 1,500 volts as a maximum for line voltages not exceeding 500; he had noticed in many cases that 2,000 was specified. Although the machine might actually stand a flash test of 2,000, there was danger of perforating the insulation, and if there was such a weak place it might break down in working a few months afterwards. The standardisation of brushes, from the point of view of the station engineer who might have a great many motors on hire, was of great importance. He did not think there would be any great benefit in reducing the

period of test for small machines, but it might be an economy with larger sizes. At the same time, he did not think it would be advisable to run a machine for mechanical reasons much less than five or six hours.

MR. EUSTACE R. CONDER (communicated) said that Dr. Pohl did not mention a flash test between phase windings in A.C. machines. He considered it very desirable, because it was not uncommon for the insulation to break down between phase windings. Some reputable makers put less insulation between phases than to earth; yet with the system completely insulated, or the neutral point earthed, there was a greater pressure between phase windings than to earth.

MR. LLEWELLYN FOSTER (Manchester) said that now there were so many "intermittently" rated motors, it was essential there should be a sub-division of that particular class. Coal-cutter motors were intermittently used, and were subject to very severe strains; in his opinion they were quite wrongly rated at the present time. A coal-cutter motor of standard make was run for three hours at its full rated load, and its temperature rise was as follows: Armature, 152°; magnet coils, 151°; and the commutator, 98° F. As these figures were taken by a thermometer on the surface, it was certain that the inside of the windings was very hot indeed. The question of rating this class of machine was particularly important. He quite agreed that the output of a motor for "intermittent" working should be the output at which, with suitable attention, it could work from week-end to week-end intermittently with the specified load factor. This load factor might with advantage be standardised as ½, ¼ and ¼. All motors should be clearly marked to indicate whether intended for continuous or intermittent working. The author suggested that there should be practically no sparking; he would rather say no sparking, and also omit any reference to the brushes, which should be fixed. An overload capacity of 25 per cent. and even 50 per cent. was often called for; this must be quite unnecessary. If a bigger machine were wanted, why not ask for it? The method of ascertaining the efficiency should be clearly specified. With regard to a temperature of 257° F. as a limit, it seemed to him that the insulation (such as was generally used in the construction of an armature) would be very dry and brittle in quite a short time, if subjected to such a temperature or anywhere near it. The insulation between magnet coils and the frame should be as good as possible, and every care should be taken to make sure that no relative movement took place between the wound coil and the pole. On all motors connected to a three-wire system, there was always one-half the supply voltage between copper and iron, and so between the windings and the earthed frame, ready to break down the insulation. He agreed that the standard temperature of the surrounding atmosphere when making a test might with advantage be increased from 25° to 35° C. Something might be done in the way of standardisation in arriving at a conclusion as to a suitable allowance for "watts per square inch dissipating surface," for partially and totally enclosed machines. A large manufacturer allowed '3 watt per square inch of total radiating surface, for quite small machines. For larger machines over 5 KW. and under 20 KW., '45 to '5 watt if a fan was used on the armature—these figures to be multiplied by two if the machine were totally enclosed. For large machines, the usual figure appeared to be 2 sq. in. per watt. Regarding the duration of tests, the suggestion made by Dr. Pohl was, to his mind, a good one. "Standardisation of pressures, frequencies, outputs and speeds," was perhaps the most important part of the paper, and nothing would please him better than to see the machines properly standardised. There seemed to be a tendency for the voltage to become lower rather than higher, due to the adoption of the lower-voltage metal-filament lamps.

MR. H. E. YERBURY said it would be to the advantage of the user if some standard could be framed and adopted for the mechanical as well as the electrical design of machines. A standard ratio of bearing surface to diameter of shaft could readily be adopted. Many engineers were unfamiliar with the existing British standards, and it was regrettable to find that some manufacturers ignored the British standard specifications, even when specified by engineers. Whatever standards were adopted, excellence of design and efficiency would still be the predominent factors when orders were being placed. Some of the recommendations of the author were so important that he hoped the Institution, together with the British Manufacturers' Association, would see their way to form a committee and investigate these points and compare them with foreign ratings. The author's remarks *re* temperature rise and methods of taking it were extremely important, and his suggestion of an internal thermometer was more suitable for general use than the resistance method. Many years ago he experimented with asbestos-covered wires for motor field coils, and the results proved so satisfactory that it was now standard. These coils, of course, were unimpregnated, and they could be worked at a very high temperature without disastrous results.

MR. WILSON HARTNELL said the thickness of the commutator segments must not only be sufficient for reasonable wear, but sufficient to leave a margin of transverse strength when the commutator was worn out. The question of overload capacity from a commercial point of view seemed to have been forgotten by the scientific men, but not by Dr. Pohl. No manufacturer wanted a motor except as a necessary means to an end. In these competitive times the business man wanted to pay a minimum price for the power he had decided to be necessary. The manufacturer should be offered what he demanded, with a nominal margin. In the competition of the world their foreign friends had an advantage, because they specified and made motors to do the working load named, but not to do much more. If we get an inquiry from Japan or South Africa, and used the English specification, the chances were that the purchaser only perceived that we were dearer than Europe or America. If we were to compete in the business of the world, we must be somewhere in line with the Continental markets. With reference to the temperature rise, the limits must in practice vary with the conditions of service. From many years' experience with repairs of various makes of dynamos and motors, he concluded that the failure of a shunt coil from high internal temperature under ordinary working conditions was very rare.

MR. W. E. FRENCH (Leeds University) said that a one hour test for intermittent working was not a proper test at all. Anyone who had dealt with the testing of motors for intermittent service or traction work would agree with Dr. Pohl that the machine thus tested was far too big for the purpose. With regard to the introduction by Dr. Pohl of flame-proof machines, the adoption of standards appeared somewhat premature. He had investigated this point and found that in very few instances had any reliable tests been made by the manufacturers when adopting the flame-proofing on their machines, and where it had been adopted, they had done so entirely on the German basis. The German tests which had been carried out in Bochum were incomplete; all the tests had been carried out entirely in still atmosphere and not in the presence of coal dust. The velocity of the surrounding atmosphere had a great bearing on the matter, and as they invariably had to deal with considerable velocities in mines, it was very likely that apparatus found safe in the German tests might fail in experiments that were about to be made. Sparklessness was a question that should also be standardised. He could not agree with the first part of the German specification with regard to shift of brushes, but he thought the second part was fair and acceptable, viz., that they limited the outputs of a machine for which the brush position was to remain unaltered from ¼ load to full load; that was all that need reasonably be expected from a machine. That the brush should remain untouched was entirely on the supposition of using commutating poles. The insulation of a machine should be tested hot, or at its final temperature. One minute was somewhat long; half that time was sufficient to show any defects in the insulation, and longer periods only tended to weaken the insulation unnecessarily. In the A.C. system, twice the voltage for the flash tests might meet the case. The author's scheme and tables of speed, &c., were excellent and met the designer's view to the fullest extent, at the same time giving the users a very free choice in speeds and outputs.

MR. T. HARDING CHURTON said the first step that was necessary in order to bring about general standardisation of electrical machinery was the reduction, as far as possible, in the variety of electrical supply systems; so great a variety was unfavourable to the production for stock of machinery such as motors. One difficulty in the way of the adoption of certain standard outputs for motors was that it might tend to impede progress in the design and manufacture of such machines. For example, a motor that at present gave 10 B.H.P. under certain conditions, might, by the use of improved material or ventilation, be made to develop 11 or 12 H.P. Why should the manufacturer be precluded from rating the motor at its true value, in the event of this not happening to correspond with an arbitrary standard? It was most urgently necessary for the Engineering Standards Committee, or the Institution, to take in hand the revision of the Report on the rating and testing of electrical machinery, already too long delayed.

DR. R. POHL, in reply, said he was confident that consulting engineers would ultimately agree that the adoption of standards which had been evolved by consideration of a representative body such as the Institution or the British Standards Committee, was in the interest of all parties concerned. Mr. Emmott's remarks fully bore this out. He was particularly anxious to avoid staudardisation where it might impede progress, and for this reason he disagreed with the suggestion of standardising brushes and other mechanical parts. Special machines need not be considered in lists of standard machines. Mr. Foster was one of the few engineers who realised the absurdity of the requirements as to overload capacity to be found in most British specifications. Mr. Hartnell pointed out very clearly that what was wanted was a motor to do certain work, and that it was foolish to specify, say, 25 per cent. overload for a great length of time, or even continually. If they wanted a 10-H.P. motor to run at 25 per cent. overload continuously they might as well call it a 12-H.P. machine. He was fully in agreement with Mr. Foster that no sparking should be permitted which would prevent the commutator from forming and maintaining a bright surface. He agreed with Mr. French's statement that it was very difficult to get constant brush position without interpoles, but nowadays it was out of the question to expect people to move the brushes when the load came on. Where they did not wish to employ commutating poles, there was no alternative but to use a larger machine. In his view the flash pressure to earth should also apply between phases where these phases were insulated from one another under working conditions, for instance, in the case of two-phase windings. For theoretical and practical reasons, however, a different test should apply for windings permanently joined at one or more points, such as three-phase windings. For such machines, he suggested that an insulation test between phases might be carried out by raising the speed and over-exciting the field so as to obtain a pressure between the terminals 50 per cent. above the highest working pressure. It was proved conclusively by the experiments at the National Physical Laboratory, that 125° C. was the safe limit for cotton. According to his suggestion, this temperature would only be approached in the central parts of field coils, where they had not to deal with presspahn, but only with cotton. In all modern machines the field coils were thoroughly impregnated after being dried in vacuum, which made them capable of standing a higher temperature than ordinary cotton. He was certain this specification

was quite safe, considering that the external parts of the coils, where they had presspahn and other insulating materials, were, of course, at a much lower temperature. There were numerous machines, the field coils of which had an internal temperature above 125° C., which had been running for 20 years or more, and they were entirely satisfactory. This proved conclusively that the internal temperature suggested was within the limits of safety. Mr. French's statements on the effects of carbon dust on the explosion pressure confirmed the view he had held all along, that the long-joint type of flame-proof motor was greatly superior as regards safety to the grid type. It was a fallacy to believe that standardisation of outputs and minimum performance meant stagnation, otherwise he would oppose it strenuously.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

E.A.C. Starter.

In cases where an ordinary shunt regulator is used in connection with remote control of a variable-speed motor some difficulty arises if the speed variation covers a wide range; if no special device is used, and the regulator has been set for a fairly high speed, there will only be a weak field for starting purposes.

If the shunt regulator is provided with an interlock, so that full field is ensured on starting, the regulator must be operated by hand before the motor can attain the speed it had before last shutting down.

The automatic starter is sometimes provided with an interlock giving full field while starting, and cutting in the resistance in one step after the armature resistance is cut out; this, however, is not advisable where the possible variation of speed on the shunt has more than a small value.

In the automatic starter and shunt regulator, manufactured by THE ELECTRICAL APPARATUS CO., of South Lambeth Road, S.E., this limitation is overcome by cutting this resistance in in a number of steps. These steps are cross-connected to the shunt regulator

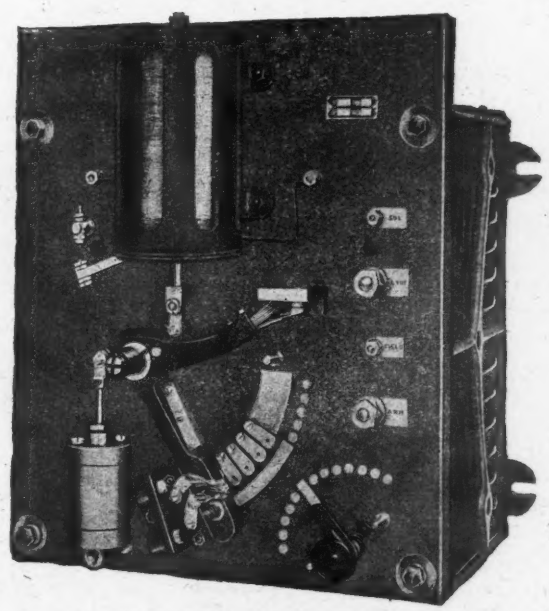


FIG. 1.—E.A.C. AUTOMATIC STARTER.

proper, which is mounted on the same base as the automatic starter. The wiring is such that the motor accelerates in a perfectly steady manner to the speed for which the regulator is set.

The automatic starter proper is of the firm's well-known patented type, in which the main switch and starting lever are operated by the same solenoid; the former always makes and breaks the main circuit with a snap; the latter speeds up the motor at a rate that can be adjusted on the dash pot. The whole forms a self-contained piece of apparatus, which is useful for a wide variety of applications, including the control of printing presses.

A Sign Projector.

We are informed by MESSRS. SIEMENS BROS. DYNAMO WORKS LTD., Dalston, N.E., that they have taken up the sole selling agency for the United Kingdom for the sign projector described on page 1087 of our last issue, and that it will be known as the "Witerite" sign.

A Lundberg Development in Two-way Wiring.

MESSRS. A. P. LUNDBERG & SONS, of Liverpool Road, Islington, whose versatility in small switch work is well known, point out that one of the uses of their standard two-way "Tripin" combination is to give two-way control from its own switch and from another, on the fitting in a flexible circuit.

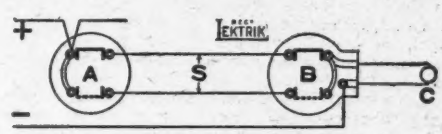


FIG. 2.

Fig. 2 shows at B the modified "Tripin" combination, and at A a fixed "pivot" two-way switch. Between A and B "pivot intermediate" switches may be connected to give additional control points. C is the portable lamp or other current-consuming device, and S the two-way strapping wires.

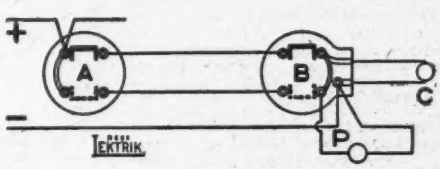


FIG. 3.

When C is a non-luminous heater, a small pilot lamp P, fixed near B or A (or anywhere else), may be connected, as shown in fig. 3, or P may be a fixed lamp in parallel with the portable one in fig. 2.

Tee Connection.

MESSRS. SIMPLEX CONDUITS, LTD., of Garrison Lane, Birmingham, have introduced some new porcelain interiors for use with their standard fittings. No. 5,434 fits into a circular box and provides for connections to a switch point and lamp point without severing

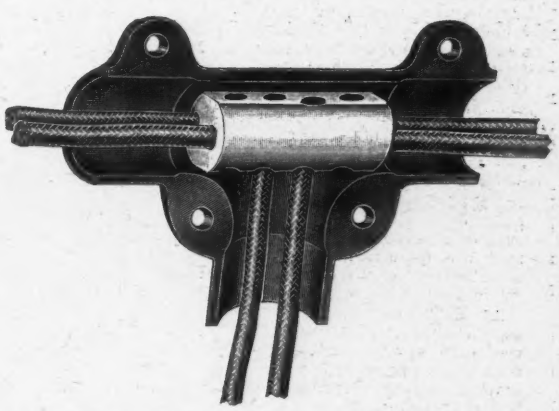


FIG. 4.—SIMPLEX TEE-CONNECTION INTERIOR.

the main wires, which drop into slotted terminals. No. 5,435 is designed for tee connections between small wires, and can be used inside the ¾-in. split tee pieces, as shown in fig. 4. A third interior is made S.P., D.P. and three-way, and fits into a 2-in. circular box.

"M.E." Printing Motor Equipment.

We are informed that this device, though called a "slipping clutch," is really regenerative, supplying current to the mains whenever there is a difference in speed between the motor and the driving pinion. This being so, the system is highly efficient, and the remarks at the end of our note of December 22nd do not apply to it.

Crypto Transformer.

THE CRYPTO ELECTRICAL CO., of 149, Bermondsey Street, S.E., have introduced a small machine for converting D.C. to A.C. for generating ozone, stepping up to high voltage for insulation testing, &c. It consists of a D.C. motor mounted in the same case with an alternator giving from 100 to 2,000 watts at any voltage from 50 to 250 volts, and any frequency between 40 and 60 with four poles, or between 80 and 125 with eight poles. The motor can be wound for any voltage up to 480, and can also be used as an exciter for the alternator when, in the absence of a supply of electricity, the latter has to be driven by mechanical power.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this Journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

28,420. "Miners' safety lamp electric light fitting." D. Morrison. December 18th.

28,425. "Electric drive of machine tools." F. Greenhalgh. December 18th.

28,431. "Power systems with electric transmission for operating machinery in factories and other workplaces." N. J. Porter. December 18th.

28,459. "Electric conductors." M. Kallmann. (Convention date, December 16th, 1910, Germany.) December 18th. (Complete.)

28,488. "Electric door operators." T. Nakahara. December 18th. (Complete.)

28,506. "Holders for articles to be treated by electro-deposition." C. Boirre. December 18th. (Complete.)

28,511. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) December 18th.

28,576. "Manufacture of metallic-filament incandescent lamps." Deutsche Gasglühlicht Akt.-Ges. (Auer Ges.) (Convention date, July 19th, 1911, Germany.) December 19th. (Complete.)

28,581. "Electrical driving of ring-spinning and doubling frames." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke, G.m.b.H., Germany.) December 19th.

28,610. "Electrical time switches." W. Hamilton and Ferranti, Ltd. (Addition to 13,704, 1910.) December 19th.

28,633. "Multiple grasping ball." E. Ducasson & Co. (Convention date, December 19th, 1910, Belgium.) December 19th. (Complete.)

28,634. "Witness post with automatic regulator of radiation for emitter of Hertzian waves." E. Ducasson & Co. (Convention date, December 19th, 1910, Belgium.) December 19th. (Complete.)

28,635. "Integrator receptor of Hertzian waves with telebolometer and rythmograph." E. Ducasson & Co. (Convention date, December 19th, 1910, Belgium.) December 19th. (Complete.)

28,636. "Isocymogenic apparatus permitting the emission of steady waves in time and space." E. Ducasson & Co. (Convention date, December 19th, 1910, Belgium.) December 19th. (Complete.)

28,668. "Hoisting gear for arc lamps and other fuses." F. S. Worsley. December 20th.

28,682. "Apparatus for lifting the brushes and short-circuiting the rotor windings of alternating-current dynamo-electric machines." Bruce Peebles and Co., Ltd. (Incorporated, 1908) and F. G. Brookhouse. December 20th. (Complete.)

28,711. "Electricity controlling switches." Soc. H. Lapipe and Ch. Wittmann. (Convention date, December 20th, 1910, France.) December 20th. (Complete.)

28,715. "Method and device for polarising magneto electrical machines." E. Volkers. (Convention date, January 3rd, 1911, Germany.) December 20th. (Complete.)

28,720. "Electric heating apparatus for grilling or for other heating purposes." J. Lawrence. December 20th.

28,747. "Voltage regulators for electric generators." A. H. Olmsted. (Convention date, December 23rd, 1910, France.) December 20th. (Complete.)

28,749. "Electric safety lamps suitable for use in mines." W. H. Lowe. December 20th.

28,750. "Dynamo-electric machines." A. Juston. (Convention date, December 27th, 1910, Germany.) December 20th. (Complete.)

28,751. "Illuminated signs for use with arc lamps." W. J. Beville. December 20th.

28,757. "Process for sterilising water or other liquids by means of ultra-violet rays produced in a quartz lamp and apparatus therefor." W. P. Thompson. (Ozonges. m.b.H., Germany.) December 10th. (Complete.)

28,766. "Dynamo-electric machines." J. Lecoche. December 21st.

28,779. "Electrical heating apparatus." E. G. Byng and C. H. Archer. December 21st. (Complete.)

28,783. "Electric purifiers for use in purifying flour, grain, rice and other substances." J. L. Lawson. December 21st. (Complete.)

28,787. "Detachable contrivance for telephone mouthpieces or transmitters." W. Cartledge. December 21st.

28,808. "Electric batteries." L. Fiedler and C. Heinrichsdorff. December 21st. (Complete.)

28,817. "Brush gear for dynamo machines." H. Leitner. December 21st.

28,837. "Wall plugs or other couplings for electrical purposes." V. C. H. Gibson. December 21st.

28,858. "Storage battery separators." W. Taylor. December 21st. (Complete.)

28,859. "Storage battery separators." W. Taylor. December 21st. (Complete.)

28,867. "Secondary or storage batteries." Ve de Karavodine. (Divided application on 2,498/1911, August 31st.) December 21st. (Complete.)

28,868. "Electrical distribution systems." British Thomson-Houston Co., Ltd., and E. B. Wedmore. (Addition to 11,979/1908). December 21st.

28,869. "Electric resistance material." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) December 21st.

28,872. "Electric fuses." O. L. Peard. December 21st.

28,879. "Alternating-current apparatus." H. W. Sullivan. December 22nd.

28,890. "Electrical equipment of roundabouts, scenic railways and the like." L. A. Hackett and E. W. Whattam. December 22nd.

28,909. "Protective devices for electric lamps." W. E. Perry and S. Davies. (Addition to 28,781/1911.) December 22nd. (Complete.)

28,913. "Electric regulating or equalising apparatus." R. Rankin and Chloride Electrical Storage Co., Ltd. December 22nd.

28,942. "Electric switches." P. Druseidt. December 22nd. (Complete.)

28,962. "Process and apparatus for the transformation of alternating current into continuous current." J. Herman and A. Kiss. December 22nd. (Complete.)

29,025. "Arrangement for electro-magnetically shifting the points of electric tramways or railways." A. M. Wylie, Jun. December 23rd.

29,027. "Intercommunication telephone systems." G. H. Nash and Western Electric Co., Ltd. December 23rd.

29,065. "Electric arc lamps." G. E. Tate. December 23rd.

29,062. "Switches for mono-rail telpher tracks and the like." R. Dempster and Sons, Ltd., and W. Mitton. December 23rd.

Southern Nigeria.—Provision is made in the estimates for 1912 of the Southern Nigeria Government for a plant to utilise the water power of the Kwa Falls in the generation of electrical energy for lighting and power purposes at Calabar.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

Overhead Electric Trolley Wires. J. W. Thompson and J. Finnigan. 1,295. January 18th.

Apparatus for the Electroplating of Crochet-Hooks and the like. Henry Milward & Sons, Ltd., and J. Smith. 1,573. January 21st.

Methods of Regulating the Frequency of Electric Currents produced by Rotary Field Generators. Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke Ges.) 2,794. February 3rd. (Patent of Addition not granted.)

Electric Alarm for Incubators and the like. A. J. Gaunt and Dairy Outfit Co. 4,580. February 23rd.

Electrical Telescopy and the like. B. Rosing. 5,269. March 2nd.

Twin or Multicore Electric Cables. C. J. Beaver and E. A. Claremont. 9,523. February 19th.

Electric Arc Lamp Electrodes. Firm of Geb. Siemens & Co. 13,817. June 8th. (June 29th, 1910.)

Means for Supporting Fire Extinguishers, Battery Cells and the like. R. Macgregor. 14,586. June 22nd.

Electrical Circuit-Breaker. Veritys, Ltd., and P. A. Hirsch. 14,812. June 26th.

Electrically-Actuated Sewing Machines. N. Redsamen. 15,690. July 6th.

Apparatus for Electric Cooking and Heating. B. Nightingall. 15,899. July 8th.

Process for Making Electric Condensers. Firm of Robert Bosch. 17,488. July 31st. (October 3rd, 1910.)

Method of Using Electric Batteries for Supplying Lamps. Chemische Fabrik Friesheim-Elektron. 22,441. October 9th. (May 24th, 1911. Addition to No. 15,447 of 1911.)

The King's Visit to India.—The Illuminations.—An Indian correspondent has furnished us with the following particulars of the scheme and plant employed for the illumination of the Great Indian Peninsula Railway Co's Administrative Offices, Victoria Terminus, Bombay, on the occasion of the King's visit:—

"The scheme, being the largest attempted in Bombay, was carried out in the following colours:—White, red, green, and purple. The total number of lamps used was about 6,200, made up as follows: 2,450 5-C.P., 2,500 8-C.P., and 900 16-C.P. carbon-filament lamps; and 350 50-C.P. metal-filament lamps; also eight flame-arc lamps, four 12-ampere, and four 9-ampere, which were used to light the interior of the Dome to show up the large stained glass windows. Two 6-ampere enclosed arcs, with red globes, were used under the centre porch.

"As far as possible the architectural lines of the building were followed, mostly in white, and all the windows were lit up from inside by hidden lamps and screens placed directly behind the windows, red and green lamps being used. Red lamps were arranged with shades and screens in such a manner as to hide the lamps and give a red reflection through the fretted balustrade, and also for outlining the pillars and arches of the verandahs. From the mouths of the 100 odd gargoyles were hung one or more 50-C.P. metal-filament lamps dipped purple, enclosed in frosted or opalescent globes, and over the central clock was fixed a fine scroll device of illuminated crystal, bearing the inscription, 'Hail, Emperor.'

"Advantage was taken of the opportunity to utilise some of the plant which had come over for the Jhansi workshops. Two 250-KW. sets were erected temporarily behind the offices, the steam for these being obtained from two large locomotive boilers at 180 lb. pressure. The switchboard was made up especially for illumination purposes, and consisted of two generator and eight feeder panels. Over the latter was fixed an illuminated plan of the building, which was arranged to indicate the position controlled by each feeder, and which lit up as the switch was closed. About 20 miles of wire were used, and the total load was over 212 KW.

"The whole of the frontage and south side were illuminated. The scheme was an undoubted success, and both the Viceroy and the Governor of Bombay, Sir George Clark, expressed their appreciation.

"Other buildings which were illuminated by gas or oil were far from being a success. Many lights were out, and the lighting looked very dull compared with those lit by electricity.

"Most of the material for the railway company's offices was supplied locally by Messrs. Greaves, Cotton & Co. The premises are the finest railway offices in the world."

A London visitor who was in Bombay at the time, writes to us commenting in terms of high praise upon the general effect of so beautiful a scheme, from a spectator's point of view. He says:—"I was fortunate enough to see all the illuminations in London at the time of the Coronation, but the finest work there falls into insignificance at the grandeur and originality of this masterpiece of electric illumination. In my opinion, no such attempt has ever been made before, and certainly no attempt has ever met with such absolute success. I hardly think the true beauty of the scheme lies so much in the blaze of light with which one is greeted, as the perfect harmony in the blend of colour, the general effect being such as to leave nothing to be wished for—no regret to be expressed.

"I think it impossible that Mr. A. A. Dixey, who was responsible for the whole work, can have received half the praise which is his due, and it is for that reason that I confidently ask you to kindly include these few lines in the columns of your paper."